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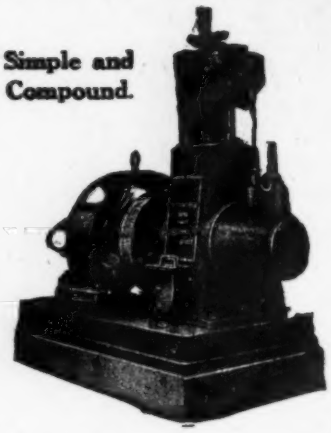

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THE IMPROVEMENT OF INDUSTRIAL RELATIONS.

WE have lately dwelt upon the need for the spirit of confidence, and in doing so we pointed out the vastness of the subject of industrial relations. We therefore make no apology for returning so soon to its consideration.

Let us begin, then, by stating boldly our opinion that the relations between the various sections of the industrial world were never better than they are to-day. It is true that—

> Hope springs eternal in the human breast;
> Man never is, but always to be, blest.

We may add to the last line that man never *is*, but always *was*, blest. One hears almost every day some such expression as "those were days, but we did not appreciate them"; "the good old times"; and so on and so forth. Yet there are few who would, even if they could, set the clock back to a former time which may seem, on looking backward, to have possessed advantages. There has always been something capable of improvement about the relations between employers and employed; and much that is in the nature of improvement has been brought about. It logically follows, therefore, that the present condition of things, although itself undeniably capable of further improvement, must be the best that has yet existed.

We hear much about the desirability of the human touch, and this is often coupled with lamentations about the disappearance of the personal contact which formerly existed between the master and his workpeople. If this personal contact was everything that could be desired—we are not denying that in some cases it may have been—why did the employed classes ever begin to realise that their interests would be best served, not by leaving things to the sense of justice of their employers, but by combining together and being loyal to one another?

There has been for a long time a general tendency towards combination, coalescence of groups, and joint action. This tendency has existed among the employers as well as among the workpeople, and so far as it tends to promote progress by the elimination of cut-throat competition, and the consequent acquisition of the wherewithal for research and advancement, combination has much to recommend it. It was stated recently by a correspondent in a contemporary, and we have not seen or heard it seriously denied, that it is more than difficult, it is next to impossible, for an individual to exchange from a position in one firm to a position in another firm in the same line of business. Combination of this character we believe to be wholly bad. It tends—or, rather, it endeavours—to restrict progress. No such endeavour can be permanently successful, but the tendency is wrong. If men find it difficult to get ahead, they will embark in something else which offers, or seems to offer, better chances. It cannot be advantageous to drive good men out of their chosen walk of life, and only the less pro-

gressive will remain in underpaid positions which offer little or no scope for advancement. And there cannot be effective progress in a profession or industry which is manned by a second-class personnel. There should be freedom of movement, and we should welcome a little more openness in the advertising of positions. Why do so many invite the applicant to reply to a box number? Why do so few state the value set upon the position? Why do so many deny the applicant a reply, even when a stamped and addressed envelope is sent with the application? And on the other side, those who seek advancement might with advantage be equally open. There is nothing to be afraid of, and if everyone could persuade himself to be frank there would be nothing unusual about it.

We do most strongly feel that the spirit of confidence would be promoted as much by candour and frankness as by any other means. All profess to be working for progress. Most people believe that progress is perpetual, and differ from Dean Inge, who says that belief in perpetual progress as a law of nature is a superstition which has no basis in history, science, or religion; civilisation has hardly changed human nature. There has been much in the last half-dozen years to emphasise what truth there is in this proposition, but we venture to think that advancement in the knowledge of nature is entitled to be described as progress. History shows progress in the conditions of living; science shows progress in knowledge. Progress in religion is more difficult to gauge; but duelling has been abolished, and much has been done for the poorest classes by people who are really philanthropists, and not big business men who rightly seek to do away with all causes of inefficiency.

Extremes are almost always wrong, and arise from a limited outlook. The extreme towards which the employer tends is the reduction of expense by every means in his power, and the appropriation of all resultant profit and advantage, even if unemployment should be the result. The extremists on the other side want the profit and advantage arising from the use of machinery and the adoption of more efficient methods to go into their own pockets. The Englishman seems to have an affinity for compromise—a sort of natural aptitude for it—and in this case, as in so many others, the right lies somewhere between the two extremes. When the manifestation takes the form of a coalition government, it is universally damned, but since it is damned for many and various reasons, all of which conflict with one another, this should not be accepted as a sufficient cause for the disregard of the principle involved.

Some of the profits arising out of increased efficiency, and consequent increased production, should go one way and some the other. The antagonism towards payment by results will, we believe, lessen, and finally disappear when it is properly understood. It is a big subject, and we do not propose to tackle it seriously at the tail end of an article. It may be taken that the ideal scheme will not be as simply and easily arrived at as is sometimes supposed. It will not do to increase payment in proportion only to increase in output. Sometimes an increase in output may result in an altogether disproportionate increase in profit—in the case of a gold mine, for example. That portion of individual remuneration which represents the cost of living should be roughly proportionate to output; but the part which represents profit, or saving capacity, should depend largely on the profit earned by the employer, and it is this part which ought to go up or down as profits fluctuate.

The ideal may be difficult of attainment, but it is not impossible, and if diligently sought after, with mutual goodwill, it ought to be achieved.

A German Misrepresentation.

In our editorial columns on December 19th, 1919, under the heading of "Who are the Buyers?" we reproduced a quotation from the annual report of the Berlin A.E.G. The extract was that the directors stated that the demand for the company's products on the part of neutral countries, and of "hitherto hostile countries," shows that German industry "still enjoys its former esteem." We ventured to express doubts as to the accuracy of the assertion in regard to Allied countries, with the exception of reparation work in France for the purpose of expediting the work of industrial reconstruction, and suggested that British firms could produce manufactures equally as good as, if not better than, the Germans'. To our astonishment these comments have been distorted into a confession of "despair," in the course of an article published in a Berlin newspaper on February 10th, by "E. Z.," who has sent us a copy of the paper with words written on it showing that he is E. Zehme, privat dozent (private coach) at the Royal Technical High School at Charlottenburg. We do not propose to discuss his abuse and depreciation of the British electrical industry, or his pointless taunt that we may find a larger export market for a time by marking British goods "Made in Germany." But before attempting to take us to task again, it would be well for this privat dozent to cultivate his knowledge of the English language so as to avoid misrepresentation of facts in the future, unless he is one of the celebrated "twisters" (Machenschaftler), of whom Germany possesses a not inconsiderable number.

The Registration of Engineers.

The Bill which the Institution of Civil Engineers has introduced into Parliament to compel all engineers practising as civil engineers to be registered, and also to prevent any unregistered civil engineer from using the letters "C.E." after his name, has naturally enough created considerable stir among the other engineering institutions. The object behind the Bill, of course, is the laudable one of improving the status of the engineer to that of the legal and medical professions, and to that, in principle, no engineer has any objection. The point in connection with the Bill of the Institution of Civil Engineers, however, is its possible detrimental effect upon the other branches of engineering, which regard themselves as on a par with civil engineering, for a clear line of demarcation between the profession of a civil engineer and other branches of engineering is not easy to draw. For instance, in the original Charter of the Institution of Civil Engineers, granted in 1828, it is stated that the signatories "have formed themselves into a society for the general advancement of mechanical science, and more particularly for promoting the acquisition of that species of knowledge which constitutes the profession of a civil engineer, being the art of directing the great sources of power in Nature for the use and convenience of man, as a means of production and of traffic in states, both for external and internal trade, as applied in the construction of roads, bridges, aqueducts, canals, river navigation and docks, for internal intercourse and exchange, and in the construction of ports, harbours, moles, breakwaters, and lighthouses, and in the art of navigation by artificial power for the purposes of commerce, and in the construction and adaptation of machinery and in the drainage of cities and towns."

This is a fairly comprehensive definition, and it is not difficult to see that it covers many branches of engineering in which there has been specialisation since it was first drawn up; for instance, mechanical engineering, electrical engineering, and municipal engineering, to mention three of the leading branches. It is not, therefore, surprising that the Councils of a number of leading engineering institutions have taken up the question of the principle involved in the Bill of the Institution of Civil Engineers with considerable activity, and interviews, of an entirely friendly character, have taken place with the Council of the Institution of Civil Engineers. There are hopes that an amicable settlement will be reached, although it is clearly understood that the other institutions are determined to oppose the Bill if it is felt that the rights and privileges of their members will be encroached upon by it. The whole question of the

registration of engineers on lines similar to those which obtain in the case of lawyers and doctors, is a broad and difficult one, and can hardly be dealt with in a sectional manner, because no branch of engineering is likely to rest contented whilst another branch receives at the hands of the Legislature privileges which can equally well be applied to all engineers. However, the negotiations between the parties are being carried on in the most friendly spirit, and if an arrangement can be come to whereby the status of all engineers can be raised to the level in public estimation which it ought to occupy, so much the better, for strife among engineers on this important question ought to be avoided at all costs. Many civil engineers, of course, are also members of the other institutions, and that in itself ought to pave the way for an arrangement to be come to which will avoid the spectacle of engineers fighting each other on this question in the Parliamentary Committee Rooms.

Relativity.

In a letter printed in our "Correspondence" columns, Mr. Carl Hering gently satirises the Einstein theory, which seems to be incapable of statement in the vulgar tongue. As a matter of sober fact, we are not at all sure that Mr. Hering's humorous proposition is not really in accordance with the theory, in which time appears to constitute a fourth dimension—and time is associated with motion. But we may point out that a straight line may be moved without generating a surface, and a plane without generating a volume. Whether a solid may be moved without introducing a fourth dimension we are unable to say, but assuming that the motion of a solid most closely analogous to that of Mr. Hering's plane is expansion or contraction, we again meet with the question whether time is a dimension.

We have endeavoured to provide our readers with a simple statement of the fundamental principles of the Einstein theory (see Mr. R. W. Western's article on "The Principle of Relativity Simply Explained," in our issues of September 26th and October 3rd, 1919, and editorials in our issues of November 21st and January 9th), but it must be admitted that the subject is one of immense difficulty, not only to the man in the street, but even to the expert; Sir Oliver Lodge, at a recent meeting, chaffingly asked Prof. Eddington (a leading exponent of the theory) if he thought he understood it himself!

A remarkable letter appeared in *Nature* of February 12th, signed "W. G.," in which the writer drew an extraordinary parallel between the non-Euclidean geometry of the Einstein theory, and the conditions obtaining in the space behind a convex mirror; the article is most ably written, extremely interesting, and well worth reading. The author quaintly and appropriately winds up with a reference to "Alice through the Looking-Glass": "According to the theory of relativity, if the observer is moving with the velocity of light, time remains unchanged. This must have been the case with the Mad Hatter. With him it was always six o'clock, and always tea-time."

"Read, Mark, Learn and . . ."

We wonder how many of the engineers or managers of the five-hundred-odd electricity undertakings scattered up and down the country could pass even an elementary examination on the provisions of the various Electric Lighting Acts. One might, perhaps, be surprised to find how few had more than a bowing acquaintance with them, to say nothing of those to whom they are little more than a name. Of course, with big undertakings, a good knowledge of the Acts is necessary, otherwise one is sure to land in pitfalls. But with small undertakings, it is surprising how, with luck, an almost complete ignorance may go on, year after year, in unbroken serenity. We say with luck, but as one cannot always rely on luck, it is the more politic course, perhaps, to browse occasionally on the wise (or unwise) provisions, restrictions and regulations that legislators have laid down for the guidance, or coercion, of undertakings in these Acts. Further, there is the chance of becoming aware of privileges hitherto neglected. As a matter of fact, the total volume of these Acts, including the new Act of 1919, is anything but formidable. And in this case, a "little learning" is just the reverse of a dangerous thing. There are many cases that may crop up with consumers, especially with ingenious, litigious-minded consumers, where a manager would feel all the happier for being able to speak with confidence. There are always a certain number of consumers who can be trusted to pull the leg of the undertaking if they get a chance, and a further quota of consumers who, less innocently, are not averse to taking advantage of the company if they get the slightest opening. Anyhow, one can never tell when such knowledge will come in useful. We heard of such a case, where the quoting of an Act, united perhaps with a modicum of bluff, got over an awkward situation. A truculent kinema manager who had come to cross-purposes with the supply undertaking, finding that some offices above his premises were supplied through leads taken into his cut-out, took revenge by disconnecting these, boasting of it, and refusing admittance. The upstairs offices, of course, clamoured straightway for their lighting. The manager of the undertaking, however, remembered that anyone who unlawfully and maliciously tampers with electric wires with intent to cut off the supply is guilty of a "felony." It needed only a telephone intimation to be conveyed to the offices of the kinematograph company that unless admission was given immediately to the undertaking's man in order to reconnect, a policeman and a charge of felony would be the consequence. Admittance was given straightway, merely on the *personal* threat, which the Act allowed. Or, again, perhaps everyone does not know that an undertaking can refuse to give supply to any person or company whose payments are in arrears, whether in respect of premises to which supply is required, or other premises where the same person takes supply. Or on the question of deposits, it is a useful point to know that where a deposit is being overstepped, an adequate deposit can be demanded on seven days' notice, and if it is not forthcoming supply can be discontinued. Also that if an undertaking has to be cut off for non-payment of account, it can charge for the expenses of disconnection. These are only random points out of the many in the Acts concerning the relations of consumer and undertaking, all of which should be known. Properly, of course, not only the manager, but all officials who are brought into contact with consumers, should, as a necessary part of their duties, be required to "read, mark, learn," and have at their fingers' ends, all the chief points of the Acts as regards duties to and of consumers.

Agricultural Exhibition at Darlington.

On Tuesday, June 29th, the Royal Agricultural Society of England will open its annual show at Darlington. We may remind our readers that the scope of this well-known exhibition is a very wide one, and that it affords an excellent opportunity for bringing electrical apparatus to the notice of farmers and other residents in the country, as well as town-dwellers, thus opening a market of unlimited possibilities. Last year, at Cardiff, the local supply authorities took advantage of the occasion to organise a publicity effort on a large scale, with gratifying results, and it is to be hoped that the Electricity Committee at Darlington will not let slip the chance of going one better.

The agricultural implement trials do not yet provide a class for electrical ploughing, except under the head of self-propelled ploughs, for which medals and prizes are offered; but electric motors and electrically-driven machines can be exhibited, though, so far as we can ascertain from the regulations, no explicit provision is made for a supply of electricity for the purpose of showing them in motion—a regettable oversight, which may, perhaps, be only apparent. The directors of so important a show ought to lead the way in a matter such as this, not to wait until the question is forced upon their notice. In addition to agricultural articles, there are many categories under which other electrical appliances may be shown, such as carriages, cycles, industrial vehicles, washing machines, culinary appliances, ice-making machines, domestic appliances and household fittings, driving belts, books, sewing machines, lubricators, &c. All such entries must be made on or before March 20th, but agricultural articles can be entered up to April 1st, on payment of double fees. We hope the electrical industries will be strongly represented.

A NEW METHOD OF MEASURING HEAVY DIRECT CURRENTS.

By R. E. NEALE.

The usual method of measuring heavy direct currents is by means of a moving-coil ammeter (of the millivoltmeter type) connected to the terminals of a shunt in the main circuit. This method is satisfactory when the measuring instrument is not far from the heavy-current conductor, except that the energy loss in the shunt itself becomes a serious item if very heavy currents are carried. If, however, the measuring instrument be 200 or 300 yards from the heavy-current cable, the pilot leads must be of large cross-section in order that the drop in them may be a minimum, and even then the voltage drop which must be provided across the terminals of the shunt, in order to obtain satisfactory operation, is so high that there is serious dissipation of energy in the shunt. If measurements are to be over yet longer distances, the cost of pilot leads and the loss in the main shunt become almost prohibitive. In order to overcome these difficulties, reliance has been placed in the past upon telephonic communication of instrument readings, or upon the use of repeating instruments of various kinds.

An interesting and entirely novel method of measuring heavy direct currents at a distance has been devised by Ernst Besag, and is now in use at Frankfort-on-Main. The following particulars are from an article in *Elektrotechnische Zeitschrift*. The method depends upon change in the choking effect of a choking coil fed with alternating current, when the iron core of the coil is magnetised by the direct current to be measured as well as by the alternating

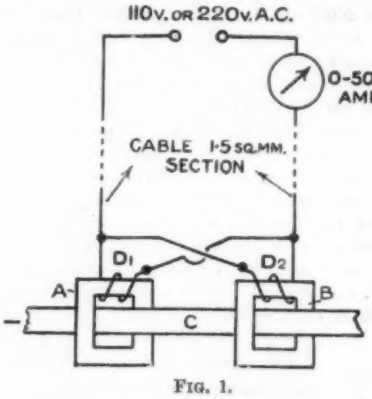

Fig. 1.

current. Referring to fig. 1, the heavy-current conductor, C, is surrounded by two iron ring-cores, on which are wound the coils D_1, D_2. These coils are connected so that there is no resultant effect on the current in C due to transformer effect from the alternating-current windings. The terminals of the latter are connected to the distant station, as shown, and an alternating-current ammeter is placed where the current indications are required; A.C. supply at 110 volts or 220 volts is connected to the measuring circuit, and it is necessary that this supply be of constant voltage, frequency, and wave form, within the limits now usual in turbo-alternator stations.

When there is no current flowing in C, the coils D_1, D_2 exert an almost pure choking effect, and the A.C. ammeter reads practically zero. As the current in C increases, so does the magnetic saturation of the cores A and B, hence the choking effect of D_1, D_2 decreases, and the alternating current in the measuring circuit increases. For each value of the main direct current there is a definite value of the alternating current, hence the A.C. ammeter may be calibrated to read directly the direct-current amperes. By using a pressure of 110 or 220 volts in the A.C. circuit, the requisite current may be kept so low that quite small leads may be used without introducing any appreciable error from the voltage drop in these conductors.

The municipal tramway network of Frankfort-on-Main is supplied principally by turbo-generators in the No. 1 station, but if the capacity of the latter is exceeded the surplus requirements are supplied from a converter station, which is about 2½ km. from the generating station. Hitherto the economical distribution of load between the new plants has necessitated continuous telephonic communication, but the new system of measurement has now been adopted, and there is in the generating station an A.C. ammeter calibrated to read up to 5,000 amperes D.C., and connected to choking coils in the sub-station by a pair of 1·5 sq. mm. leads. The sub-station is similarly equipped with a 5,000-ampere ammeter, indicating the bus-bar load on the generating station. The resistance of each measuring circuit is about 70 ohms, and the town supply of 120 volts, 45·3 cycles is used in the measuring circuit.

The oscillograms reproduced in fig. 2 were obtained by using the power supply (220 volts, 45·3 cycles) in the measuring circuit and by replacing the heavy-current conductor C (fig. 1), for the purpose of this test, by a D.C. winding on each iron core. When the direct current was zero, the A.C. in the measuring circuit was almost exactly 90° out of phase with the impressed voltage. With increasing values of direct current, the alternating current increased as shown, and its phase displacement was reduced, but never fell below about 70°, so that the power consumption in the A.C. circuit remained small throughout. The current values shown in fig. 2 are the values of direct current used in the auxiliary winding of the iron cores, and not the A.C. amperes in the measuring circuit.

Under the conditions obtaining in Frankfort, heavy direct currents may be measured by this method with an error not exceeding ± 2 per cent.

Apart from its value in long-distance measurement, the new method offers the advantage of eliminating shunt losses

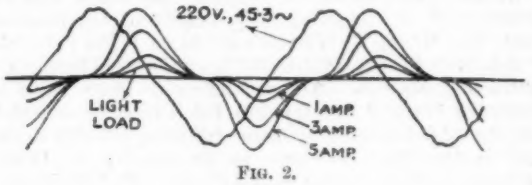

Fig. 2.

which are serious, where heavy currents are concerned, even if the indicating instrument be near the main conductor. Another advantage, which will be more appreciated now that high-tension D.C. is being used so extensively for traction purposes, is that the pilot leads used in Besag's method need be insulated only for 110 or 220 volts D.C., and not for the voltage of the main circuit. Apart from the economy thus effected, operating risks are reduced by eliminating direct electrical connection between the switchboard and the high-voltage D.C. circuit. An important possible application of the new method is to the measurement of the charging or discharging current of cells in a distant battery sub-station.

Alternating current for the measuring circuit is almost invariably available in these days of A.C. generation and transmission, and if it were not immediately available, it would often be worth while to install a small converter in order to make possible the use of this method.

(A possible modification of this method which suggests itself would be to use a single iron core round the heavy D.C. conductor, say, A, fig. 1, and to connect a winding D_1 on this core to a fluxmeter. The fluxmeter being set to zero when no current was flowing in C, the deflection of the instrument should thereafter be proportional to the magnetisation of A, and thus to the current flowing in C. The law would not be linear, owing to magnetic saturation of the iron core, but it would be practicable to calibrate the fluxmeter to indicate directly the corresponding values of the main current. This method would not be applicable to long-distance measurement, owing to the very small E.M.F.'s produced by changes in the magnetisation of A, but it may have its application in certain special cases, and if so, it would offer the advantage of eliminating the A.C. supply required by Besag's method. Errors due to hysteresis and remanent magnetism could generally be minimised by providing a suitable air gap in the magnetic circuit.—Eds.)

MAGNETIC STORMS AS AFFECTING OCEAN TELEGRAPH CABLES.

(Supplementary Notes.)

By EDWARD RAYMOND-BARKER.

Since the appearance of the article under the above heading in The Electrical Review of December 19th and December 26th, 1919, appreciative letters from observatory and from ocean cable telegraph stations have reached the present writer.

A leading authority at a great cable station, writing on this subject for the first time, has used the following words: "Your suggestion is a good one, and ought to find place with all cable administrations . . ."

Letters, in fact, show that the writer's plea for advisory notices by "wireless" has been endorsed by excellent authority, and, therefore, holds good. That is to say, the proposal is recognised as a good one, that on occasions—fortunately of rare occurrence—of serious magnetic disturbance, especially when this evinces abrupt variations of magnetic force, notice from the Director of the Meteorological Office should be spread abroad by "wireless" as early as practicable to cable stations and especially to cable-repair ships on the high seas.

Owing to the protective action of the cable condensers which, when unshunted, block out all earth currents excepting those characterised by *abrupt* changes in polarity or in potential, a cable station staff intent on maintaining, by auto-transmission and auto-relays or amplifiers, uninterrupted duplex flow of message traffic, might, during the *earlier* stages of a magnetic storm, remain quite unaware of impending trouble, and so would cordially welcome the magnetic observatory's timely intimation.

By the electrical staff on a cable ship, cut off from much information known at the cable stations, and about to cut into a cable just raised, perhaps, through some three miles depth of water (see E.R., December 26th, 1919, col. 1, line 35), magnetic storm data certainly would be very keenly appreciated.

In this connection, it is interesting to note that, as regards the famous magnetic storm of August 11th and 12th last, news to hand from a big station informs us that, at the end of the storm, two, if not three, faults directly due to its effects were found in the cables.

So far, then, this suggestion as to "wirelessed" advisory notices from the Meteorological Office has met with approval; nevertheless, the present writer, apparently, has gone too far in his assumption that magnetic storm *forecasts* would be practicable. In like manner, in his former article, he has gone astray in assuming that the routine information, issued—as Dr. Chree in his I.E.E. lecture has told us—week by week by the Director of the Meteorological Office to the Institution of Mining Engineers, customarily includes *warnings* of approaching magnetic storms.

In a generously informative letter (December 31st) to the present writer, Dr. Charles Chree, F.R.S., Superintendent of Kew Observatory, has shown that "what is issued for the benefit of mining engineers is historical not prophetic information."

"Every Wednesday," Dr. Chree tells us, "the magnetic history of the week ending on the previous Saturday" is sent from Kew Observatory to "certain journals. . . . No journal other than those devoted to mining interests has as yet applied for the information."

Furthermore, Dr. Chree's letter states that the photographic sheet upon which magnetic variations are recorded, serves for two successive days before it is taken from the instrument to be developed, so that, altogether, in the normal course of events, without special arrangements being made, two or three days must elapse on the average before the complete information relative to any particular day becomes available.

However, as Dr. Chree now points out: "If obtaining very early information were considered important enough to make the question of cost immaterial, special arrangements could be made, *e.g.*, an eye-reading instrument would be set up and read at frequent intervals, or a special magnetograph could be set up with arrangements for developing the record at short intervals."

The Rev. Father A. L. Cortie, S.J., Director of Stonyhurst College Observatory, likewise has most kindly found time to write on the same subject about which he makes, *inter alia*, the following observations:

". . . The difficulty of giving warnings is that since the records are photographic, one cannot tell that the magnets have been disturbed until the curves have been developed. We can take eye observations, but no one as a rule thinks of looking through the telescopes until we know that a disturbance is taking place. Pen and ink records on a drum would be preferable for all self-recording instruments. . . ."

From all the foregoing matter, one may draw the following conclusions:—

If ocean telegraph cable authorities thought it desirable to acquire from the Meteorological Office notification of serious magnetic disturbance, and were ready to make good any additional expenditure, magnetic observatories would have it in their power to make special arrangements for early detection of any heavy perturbations that might occur.

Long-range radio systems, Admiralty or Marconi or Tour Eiffel, amongst others, might be utilised to reach distant cable ships known to be at work. As already mentioned in a former article, many cable stations now have their own antennæ, though what their actual transmission range amounts to, the writer is unable to state. Cable stations would, in many cases, be able to verify observatory warnings as to threatening earth-current disturbances, though it must not be forgotten that, as Dr. Chree now tells us, "there are storms and storms. Only some seem to have large accompanying earth currents; those apparently in which there are specially rapid magnetic oscillations are the most disturbing."

Finally, one cannot refrain from suggesting that once it be deemed desirable for the well-being, whether of mining engineers or of the cable telegraph service, to see and appreciate magnetometric conditions at any given moment, at a glance, a spare magnetic *declination* bar might be arranged and set up as a non-recording instrument.

Protected from draughts in a glazed case and with condensed light thrown on to the fixed and the movable half-disk mirrors (*fixed* for zero and *movable* for variations), reflected luminous images or "spots" of considerable size might be projected an extensive radial distance; the movable "spot" being free to sweep the whole length of a long and wide graduated scale. This arrangement would offer the utmost facility for cursory inspection by an observer normally engaged in other work, but always within view of the great graduated scale.

In concluding these few notes, one may be allowed to mention that a detailed and beautifully illustrated description of photographically self-recording magnetometers, as used at Kew and at Stonyhurst College, is given in Gordon's "Physical Treatise on Electricity and Magnetism," Vol. 1 (Samson Low, Marston & Co., Ltd., 100, Southwark Street, London, S.E. 1).

Since the above was written, The Electrical Review, January 16th, 1920, p. 82, under the heading "Wireless Meteorological Information;" has published an interesting quotation from an Admiralty notice to

mariners in the *London Gazette*, January 6th. In it occur the following words: "... Negotiations are in hand to extend and unify the system of collecting weather data by wireless from ships at sea all over the world, and, at the same time, to organise the free transmission of weather bulletins *to admit of ships being constantly supplied with reliable weather reports and forecasts wherever they may be* ...." (Italics, the writer's.)

Clearly, once the radiotelegraphic distribution of magnetic-storm notices to ships at work on submarine cables has officially been recognised as desirable, it is evident that the necessary organisation for the said distribution of information lies here ready at hand.

THE WORKING CONDITIONS OF MAINS STAFFS.

By WILFRED WELLS.

The notion that he works considerably harder than the average person is a harmless conceit, shared, we suppose, by most men. The number of persons in the world having soft jobs is by no means negligible, but rarely will one find a man who will admit that he has one. Rather, such individuals are mostly zealous in demonstrating to their acquaintances how hard they work, and how exhausting their work is. The relationship between the actual amount of work done by a man and the amount he tells other people he does, is more appropriately represented geometrically by a rectangular hyperbola, than by a straight line passing through the origin. Certainly it is a fact that the central station man, whose hours have been indefinite, and whose relaxations few, has in the past had less to say about the hardness with which he worked than have elementary school teachers, whose hours average under 30 per week, and whose annual leave is something like eight weeks.

There is little doubt, however, that in the earlier days of electricity supply, the lot of the central station man was by no means easy. The imperfections of the generating plant and switchgear of this period made the possibility of breakdown very much greater than is the case at present. And, in addition, the normal running of the station of 15 years ago was not the comparatively uneventful business it is to-day. Especially in these early days was the position of the engineer-in-charge—or the shift engineer, as he was then designated—unenviable, and it is no matter for wonder that only men of the right temperament were able to stand up to the work for any length of time. The successive advances in the design of central-station plant have largely eliminated the likelihood of breakdown and the difficulties of operation, and, with the larger units now in general use, the work of the engineer-in-charge is rather in the boiler house than in the engine room or in the switch room. The worries of the charge engineer are now much smaller, and with an adequate provision of spare plant, and some reasonably good coal, his lot, from the point of view of routine duties, is very much easier. The general adoption of a normal 48-hour week, and the improvement in rates of pay that now, happily, are becoming more general, are, of course, all to the good.

The general conditions of working for central-station staffs vary greatly with the nature of the work. The technical departments can be divided into works, mains, testing, and sales sections. Those in the testing department are in many ways the most fortunate, as their hours are fixed, and when they leave the works they do so with the assurance that they are free till the next morning. Junior members of this department may, of course, consider that the tedious nature of their work is a set-off against this advantage. The superintendent of the testing department, however, in the matter of hours, is much better circumstanced than his colleagues in other departments.

The hours of working amongst the sales or publicity staff are not so well defined, as much of this work must needs be done in the evening. The work of the sales department is, however, not largely of a routine nature, and it seems possible that arrangements can without difficulty be made whereby compensation can be obtained for evening work in the way of leave during the daytime. The fact that the remuneration of the publicity staff usually depends more or less upon the work they put in, is a further compensation for irregularity of hours.

It is when the conditions under which the works and mains staffs work are examined that real hardship is often found to exist. It does not require very much effort to demonstrate that the lot of the station superintendent of a works of moderate size, even where up-to-date plant is installed, is not all that it might be. The story so ably told by "Ann Assette" in recent issues of this journal, although erring perhaps a little on the side of exaggeration, was nevertheless in the main a true picture of the life and career of an engineer connected with the works side of central-station life. In the course of this story, however, little was said of the conditions under which the mains engineer works, the sole reference to the mains department being the mention of a Chief who spent the whole of one Christmas Day in locating a fault. However true to life such a story may have been ten or fifteen years ago, it is hardly applicable to present-day circumstances, and it is safe to assume that the average Chief of to-day, so far from spending Christmas, or for the matter of that, any other day, in locating a mains fault, would be very content to delegate this interesting job to a member of his mains staff.

The normal duties of the mains staff are fairly well defined, and are about the same in all undertakings. The time of this staff is well occupied with superintending maintenance, service, and extension works; and this work, it must be remembered, cannot always be carried out during normal working hours. Important jobs usually have to be carried out during week-ends, and these are just the jobs that require the closest and most lengthy supervision. A considerable number of hours, outside those usually considered to constitute the normal working day, have, in addition, to be devoted to testing. In addition to supervisory duties, the mains staff usually have an appreciable amount of clerical work in the office to be attended to, and in all but the larger undertakings they are expected to keep the system of plans and records up to date. The normal duties, therefore, are usually sufficient to keep the mains engineers fairly busy, although undoubtedly times of stress are more or less balanced by periods of purely routine work, when the supervision and clerical work required are fairly light. The life of a mains engineer is, moreover, a healthy one, and the freedom of movement that must necessarily be assigned to all members of the mains staff, is very congenial even to the most conscientious man who is the least likely to abuse this privilege. If the duties of a mains engineer ended here, it is probable that, as a class, they would be fairly contented with the conditions under which they worked, being quite willing to put in the extra time at week-ends that is often required.

In addition, however, to all the foregoing, there is a further call on the time and energies of the mains engineer that is based upon the principle that at all times the services of one of the mains staff shall be obtainable at short notice to deal with any cable breakdown that may take place. This, from the standpoint

of the undertaking, is perfectly reasonable, and indeed necessary, and it is sometimes assumed that in this matter the mains engineer is in a similar position to the station superintendent. This is by no means true, owing to the fact that unlike the works, the mains do not require a staff to see that they perform their functions, and that, consequently, if the smallest or most trifling of troubles occurs, there is not necessarily any man at hand to attend to it. As there is always an engineer-in-charge at the works, the difference in this respect between the station and the mains engineer is apparent.

The means adopted for complying with the theoretical requirement of the availability of mains engineers vary very greatly from place to place. Among the larger undertakings it was not unknown for three shifts of mains engineers, jointers, and mates, to be run, thus ensuring that at any hour during the day or night, an adequate staff was available to tackle a fault. In other undertakings, one or more members of the mains staff were required to be in attendance during the evenings, while in the majority of stations it was considered sufficient for one engineer to be at some known place in the town where he could receive a communication either by telephone or by messenger within a reasonably short time. The position of the mains engineer, standing by, on the occurrence of a fault, largely depended upon the arrangements made for his assistance. One engineer obviously cannot tackle a serious fault single-handed; but this obvious fact was often overlooked, with the result that the unfortunate engineer had first of all to hunt round the town for a jointer to render the necessary assistance. It is true that in most works there is a wireman or meter fixer on duty during the evening to attend to complaints of light failure, but it was useless to rely on this man for help, as it frequently happened that when wanted for this purpose he was in the furthermost corner of the district replacing a 5-ampere fuse in a distribution board. The theoretical requirement of the availability of a mains engineer for attention to breakdown is, too, often disregarded during the daytime. In one undertaking in which one engineer was supposed every evening to be in attendance at the works, it was not unusual for the whole of the technical mains staff to be out during the greater part of the day. During the time of the power load, therefore, when the consequences of a breakdown would have been most serious to the most important consumers, it might easily happen that none of the mains staff could be got at for some considerable time, and when they were, considerable difficulty might be experienced in getting a jointer to render the necessary assistance. The number of stations where arrangements are made for the services of an engineer, jointer, and mate to be instantly available during the daytime is probably very small. And yet, it cannot be denied that the shutting down of a large works is more important, if not as spectacular, as 200 yards of one side of the High Street being in darkness. It appears, therefore, that the only sure way of guarding against delay in the clearing of a mains fault, is to provide three shifts of engineers, jointers, and mates, and in any other scheme certain risks have to be run. The three shifts would, of course, entail prohibitive expenditure in all but the large undertakings, and, therefore, we find that risks have to be taken in the smaller works. These risks can, however, be minimised by a little careful arrangement, but at all events, it seems quite clear that the services of a jointer and mate should be instantly available during the evening hours, when the heavy lighting load is on. This availability can only be obtained by the attendance of these men at the works; any other system places upon the shoulders of the mains engineer on duty the additional worry and trouble of having to turn his jointer out, if a fault occurs. It will, of course, cost money to keep a jointer and mate at the works each evening, whilst the standing-by of the mains engineers is supposed to be remunerated by the salaries of these fortunate men. There is little doubt that, in times past, there has been considerable tendency to take advantage of the fact that the mains staff are salaried officials, and to require of them unfair hours of attendance, and also to saddle them with additional trouble to the all-sufficient annoyance of having to clear a cable breakdown.

There is a further aspect of the availability of the mains engineers that requires notice, and that is the fact that they are worried by any little trifling thing occurring outside the works that may require attention after working hours, unless there is a man in attendance to see to such small matters. A lamp-post, for instance, is knocked down in a remote corner of the town; it is reported to the mains engineer, and he, being a concientious man, will probably not be able to rest content till he is assured that somebody has been found to attend to the matter. There are numerous small troubles that are always likely to occur, but which do not need the attention of an engineer, and, seeing that he is not paid for the extra time he puts in, it is hardly equitable that he should be bothered with such matters as do not need his attention. Happy are the mains engineers where there is a capable mains foreman living on or near the works, who is competent to attend to all matters up to, say, and including the isolation of a faulty distributor length, and the question suggests itself why such a man is not to be found in all but the smallest undertakings. Mains engineers might well ask themselves this question, and consider whether it is not sufficient to be called out in the evening or during the night for only such matters as really require their attention, and for no others.

Enough has been written to show that the life of a mains engineer, although it has certain advantages, is not all that it might be, and the restraint upon his movements after a day's work, or, as it has been expressively styled, "being on the dog chain," is not a little irksome. A certain amount of restraint must necessarily always remain, excepting, perhaps, in the largest undertakings, but there seems no reason why it should not be very much less than it has been in many places, it seeming only right and proper that those undertakings which desire a high degree of security against delay in clearing faults should be prepared to pay for what they require.

A Swedish Company's Activity.—A heavy fall in the quotations for the shares of Luth & Rosens Elektriska Aktiebolag has induced Mr. Asel Hultman, on behalf of the directors, to give an explanation of the situation in *Svenska Dagbladet*, of February 20th, although the definite figures for 1919 have not yet been ascertained. He states that although the turnover increased from 26 millions kronor in 1918 to 29 millions last year, the results seem to show a not inconsiderable loss. This is attributed to the large fall in prices of materials and the consequent unfavourable sale prices, and the necessity for writing down the large stocks which the company was compelled to keep; to the replacement of plant, and the constant increases in wages, as it was necessary to maintain operations at the Eskilstuna Works, despite large losses. The reserve funds will be inadequate to cover the latter, and a portion must be carried forward. Mr. Hultman further states that an increased demand for the company's manufactures has been manifested in the home market in the present year (1920), and in the export market the company has succeeded in forming some valuable foreign connections, which, together with former relations, seem to hold out the prospect of yielding considerable orders to the company. The directors have taken measures for expanding the production of standard articles, and that of electrical machinery has more than doubled. Under these circumstances, the hope is expressed that the company's activity will soon again become profitable.

Railway Electrification Catalogues Wanted in Canada.—H.M. Trade Commissioner at Toronto (Mr. F. W. Field) in a communication to the D.O.T., states that Mr. S. B. Clement, chief engineer of the Temiskaming and Northern Ontario Railway (Ontario Government Railway), North Bay, Ontario, wishes to receive from United Kingdom firms interested in the electrification of steam railways, details of the work of this nature which they have done in other countries, together with catalogues and other literature on the subject. It is stated that the electrification of the Ontario Government's railway, comprising a mileage of 342 may be considered at a later date.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Electrolytic Meters.

Mr. Marshall, in his reply to our letter in the ELECTRICAL REVIEW of February 13th, speaks of the relative use of electrolytic meters; this relative comparison should be made by comparing the number of meters in use on D.C. circuits of smaller consumers—say up to 20/25 amperes capacity—which small consumers are now rapidly increasing. This is where the electrolytic meter tells, as indicated in our previous letter; when the supply is to a small consumer using one-watt or half-watt lamps, a motor meter is very apt to refuse to start, hence the increasing use of electrolytic meters of late years. Our output has, in any case, been considerably in excess of even pre-war figures in spite of difficulties as regards supplies of raw material—this latter condition we are aware applies to all—but we mention it as our output would otherwise be far greater.

As regards maintenance cost, apart from filling, this is nil; we have meters still working which were installed 25 years ago; and as regards filling, this is a minute's work, done at the time of reading, perhaps once a year or perhaps not so often.

With reference to the letter from your correspondent "A. W. C.," in your issue of the 27th ult., we would point out that *every* electrolytic meter is not affected by vibration or dampness, as neither of these will affect the Bastian electrolytic meter, nor is it necessary to make a further visit to note whether the meter is working or not. As regards life and maintenance, our letter in reply to Mr. Marshall deals with this.

The Bastian Meter Co., Ltd.,
ALBERT E. SALISBURY,
Managing Director.

London, N.W.
March 1st, 1920.

Your correspondent "A. W. C." writes in general terms on this subject, but inasmuch as his criticisms chiefly concern one type, it would appear that he has no knowledge of another, and is not, therefore, in a position to write with the authority he assumes. From the point of view of the "Bastian Meter" most of his remarks can be adequately met by a plain denial of the faults he details.

This meter is not affected by either damp or vibration. It does not require extra head-room for resetting. Anyone can see at a glance whether it is working.

The question as to who should refill or reset an electrolytic meter may well be left to the discretion of the supply authority concerned.

As regards "life," perhaps "A. W. C." will supply the data on which he bases his rather sweeping assertion.

Jas. Bastian.

London, N.
March 1st, 1920.

I have been following with interest the comments in your correspondence column with reference to Mr. Marshall's recent article on the above. Having had considerable experience under various working conditions with both types, I would like to add that in my opinion the main causes of alleged "failure" in the electrolytic meter lie not so much in the meter itself as in the position in which it is installed, and also the system under which it is read and reset upon consumers' premises. It should be borne in mind that these meters are as a rule subject to electrolysis troubles when placed in a damp atmosphere, and are also more or less apt to be affected by vibration. Care should therefore be taken to see that these conditions are not present when selecting a site for a meter of this class.

I find, however, that taking the question of meters as a whole, and where price has not been the only consideration, the mercury motor type has been found to give the greatest all-round satisfaction; nevertheless I have also found that where a cheap meter is the main object in view, and for very small consumers generally, most of the difficulties mentioned by your correspondents can be overcome by observing the following rules:—

1. Do not install in a position subject to extreme vibration, such as over or near a door that is liable to be "banged," in the vicinity of heavy machinery in motion, or a locality where the atmosphere is subjected to extreme moisture, steam, or fumes of any sort.

2. Always fix in a position where the readings may be taken on a level with the eye of the reader, as some meters are provided with scales with minute unit divisions, and it has been found that unless the eye can be placed on a level with the liquid big errors in the readings are liable to occur. (It should not be difficult to find a suitable site in the average modern small dwelling-house.)

As regards resetting, I have found that the best plan is to make a point of doing this (whether the meter requires it or not) at the reading following the period for which the account is due, and in cases of known "sceptical" consumers or an apparent abnormal consumption, the attention of the consumer concerned or a member of his household should be asked to check such reading before the meter is opened. This allows time for any disputes to be settled, and also does away with any possibility of readings getting "over the top." It need scarcely be added that all readings should be carefully entered upon the consumer's card, which should be hung near the meter.

In cases where there are a large number of small consumers supplied through these meters, it should not be considered a loss to the undertaking, if one or two have to be met occasionally over a disputed account, as the initial cost of a large number would amply compensate for this.

In conclusion, I am sure, however, that any practical suggestions regarding a cheap and efficient mercury motor meter which Mr. Marshall could offer, would be welcomed by the community at large.

J. R. Willingham.

Llanelly.
March 1st, 1920.

Electric Furnace Nomenclature.

We receive a number of inquiries from electrical firms for furnaces for "tempering" steel. In the majority of cases what is really required is a furnace for "hardening" steel.

In view of the activities of our gas friends, we think that it would be well for electrical engineers to acquaint themselves more fully with the correct technical terms.

Hardening and tempering are distinct heat treatment processes; hardening involves heating up to a high temperature, say, anything over 750 deg. C., according to the nature of the steel. Tempering involves reheating after hardening to a comparatively low temperature, generally between 200 and 300 deg. C., according to the nature of the work that the steel has subsequently to perform.

If electrical heating service is to progress, it is, in our opinion, most important that there shall be no uncertainties introduced into our speech or writings by the use of careless terminology.

Automatic and Electric Furnaces, Ltd.
E. P. BARFIELD.

London.
February 26th, 1920.

The Einstein Theory.

One of your recent editorials on the Einstein theory led me to believe that the following explanation of the fourth dimension might be of interest, if not taken too seriously. It must be conceded that it is at least logical, and that it is a clearer, briefer, and more concise statement than those of Einstein and his followers.

When a point, which has no dimensions, is moved, it generates a line, which has one dimension. When this line is moved it generates a surface, which has two dimensions. When this surface is moved is generates a solid, which has three dimensions. Hence (logically at least) when a solid is moved it should be a case of the fourth dimension. The simple, commonplace, act of throwing a brick at a man would, therefore, seem to constitute a problem in the fourth dimension.

I agree with you and others that it is very regrettable that not even those who profess to understand the Einstein theory can give a clear and simple explanation of at least the underlying principles of it, in plain, every-day English terms.

Carl Hering.

Philadelphia, U.S.A.
February 13th, 1920.

[We refer to this subject in our leading columns to-day.—EDS. ELEC. REV.]

Finland's Water Power.—According to a report by the United States Diplomatic Commissioner at Helsingfors, the water power available for Finland's industries in the many rivers of the country is quite large, but it has been much overrated. It has recently been calculated by an expert, Prof. A. Juselius, that at mean water level it may amount to 3,000,000 effective H.P., but only a fractional part can be put to practical use within the reasonably near future. A large portion of the water power is situated in parts of northern Finland so remote that for a long time to come it will be impossible to build any industrial establishment there. Furthermore, the available water power is restricted both by the stipulations in the water-power laws regarding the protection of the river channel and by agricultural interests. It should also be considered that the water power is not generally produced by high falls, but is gathered from long sloping stretches of the river; consequently the hydraulic works are very expensive. Prof. Juselius has estimated the water power that within a reasonable future will be available for Finland's industries at 900,000 H.P. effective at the shaft of the turbine.

LEGAL.

Compensation Claim.

At Blackpool County Court, on February 25th, Judge Sturges, K.C., heard an application by Mark W. Kennedy for compensation against Blackpool, St. Annes & Lytham Tramways Co. The judge adjourned the case for three months, applicant to be paid full compensation and to try the work of a switchboard attendant.

Direct W.S. Cable Co., Ltd. v. Western Union Telegraph Co., Ltd.

This action, the hearing of which was adjourned from February 23rd, did not again come before Mr. Justice Peterson, in the Chancery Division, until February 27th, when Mr. Douglas Hogg, K.C., addressed the Court for the plaintiff, and was followed on March 1st and 2nd by Mr. Mark Rome, K.C., for the defendant. He argued that it was impossible to do the repairs owing to the difficulty, during the war, of obtaining repairing ships. The interruptions complained of, he said, were the result of the action of the Admiralty alone. His Lordship reserved judgment.

Atkinson v. Newcastle Corporation.

At Newcastle-on-Tyne Assizes, on February 27th, before Justice Bailhache and a special jury, Albert Edward Atkinson, stained glass expert, brought an action against Newcastle Corporation for damages for personal injuries due to the negligence of employés in charge of a tramcar in June last.

Mr. Mitchell Innes, K.C., for the plaintiff, said the injuries received by Mr. Atkinson were of a very serious character. On the occasion of the Gosforth races, last June, Mr. Atkinson and his wife and friends went there. When they were leaving the Park, plaintiff and his wife and friends were under police direction passed through between two cars. All got through but plaintiff, and while he was passing through, the front car suddenly backed, and jammed plaintiff between the two vehicles. Both plaintiff's legs were severely crushed, the thighbone of one being broken.

Mr. F. A. Atkinson, plaintiff's brother and partner, estimated that his brother's illness had resulted in a loss of work worth £2,100 last year, the profit on which was about £1,500. This year he expected he could have got orders worth £6,000, but would be unable to execute more than half, in consequence of his brother's illness.

The jury found for the plaintiff, and awarded £1,158 14s. damages.

TRANSFORMERS FOR ELECTRIC FURNACES.

At Glasgow, on February 10th, Mr. J. L. Thompson read his paper, an abstract of which appeared in our issue of January 30th, to the Scottish Centre of the Institution of Electrical Engineers. In the subsequent discussion Mr. R. B. Mitchell said it seemed to him that the introduction of reactance is most important and essential in the case of transformers for furnace work. In comparing frequencies of 25 and 50 for furnace work there was, he understood, a considerable difference in the cost of the transformer in favour of the higher frequency. High tension tappings had all along been a source of weakness, and he dared to say would have been discarded if there had been no extra cost involved in the provision of regulating apparatus. He was certain that in spite of the extra cost, these appliances would ultimately be adopted. He accepted Mr. Thompson's statement that units of 8,000 K.V.A. capacity were probable in the future, and the handling of these loads was only one of the problems which the supply engineer would have to face. He trusted that in Glasgow, at all events, furnaces of that capacity would not be located very far away from the power station. Also it was another argument in favour of transmission cables for much higher pressures than, say, 20,000 volts. In this connection did the author think it advisable to build up to 8,000 K.V.A. capacity in one unit, and, if there were disadvantages in not doing so, what were these? In the Glasgow area there was a Scott-connected transformer for furnace work, but he had not heard that there had been any out of balance trouble on account of the connections. As to the advantages and disadvantages of the core and shell types, one usually had a natural preference in the case of ordinary power transformers for the core type on account of the accessibility of the coils. Mr. Thomson seemed to work out a case for the shell type. Had he any data as to the performances of these two types in actual work?

Mr. W. L. Wood said he had witnessed the dismantling of a furnace transformer, when it was found that the insulation of the inner portion of the winding was very brittle and in some places charred, showing that this portion developed a high temperature, and it was suggested that the more liberal use of separators providing a larger cooling surface would lengthen the life of the insulation. It was also noticed that a large amount of sludging had taken place in the transformers.

Mr. A. P. Robertson pointed out that there was enough matter for a paper on transformers for arc furnaces. The conditions were much more severe in the arc furnaces when compared with the resistance furnaces due to the short circuit when the arc was struck. One of the reasons was that the mechanism for moving the carbons was too slow. In the furnaces he had seen the arc was struck by hand, and although it might be only a second or so before the carbons were separated, this gave time for very severe stress on the transformer. If the carbons were to stick together, the transformer might be seriously damaged unless the protection on the H.T. oil break switch was very positive. The contacts of this switch required a good deal of attention, as the switch operated very frequently. The arcing tips should be extra heavy and easily renewable. With regard to the H.T. selector switches, these were often air break switches, which necessitated the use of copper rod between the switches and the transformer terminals. It was not a safe job, and the speaker believed that in more recent jobs immersed selector switches were used and solid conductors run between these and the transformer. The bracing of the L.T. leads must be very strong to keep them apart. During the time the arc was being struck, the L.T. leads vibrated very much. The flexible leads to the carbons were pulled close together and became rigid. The current during this time was very high, and was generally outside the compass of the ammeter. As the current fell, the leads lost their cohesion and became flexible again. The author mentioned that there was a probability in the near future of larger units of 8,000 K.V.A. He (Mr. Robertson) thought the transformer makers should keep in view the weights of these transformers. If necessary, they might be made in two or three smaller units worked in parallel. It was not always easy to move large weights, and the transformer houses were not always very roomy. Although the transformers were not likely to be moved once they were in position, if any repairs had to be done, the easier the units were to handle the less time would be spent in repairs. To put up a power crane for this purpose would be tying up a great amount of capital for very occasional use.

Mr. G. M. S. Sichel asked how the regulation of special transformers compared with the regulation of the ordinary industrial transformer operating at normal. The regulation would, of course, depend on the power factor of the circuit, but for the purpose of comparison they might assume similar conditions. With regard to the author's statement that the low-tension heavy current winding consisted of bare conductors, he recalled a paper read before the Institution some years ago, dealing with the formation of sludge in transformers, in which the statement was made that there was a much greater tendency for sludge to form on bare copper conductors than on conductors having a covering of insulation, and it would appear desirable that the heavy current secondary winding be covered with, say, a single layer of tape, in order to prevent the formation of sludge. The tendency to sludge was aggravated if the temperature at which the transformer was operating was high, and it was reasonable to expect higher temperatures on transformers working in proximity to furnaces than in transformers working under usual industrial conditions. Next, with regard to the protective gear required for furnace transformers; in all wiring diagrams showing the lay-out of furnace transformers the only protection provided appeared to be that afforded by the use of an ordinary time limit fuse or fuses, which shunt the oil switch trip coils; as the behaviour of the time limit fuses did not generally give constant results, he would be interested to know whether the practice of protecting furnace transformers with time limit fuses had, in the past, been found to be satisfactory, more particularly bearing in mind the extremely violent and frequent fluctuations of the current during the melting period. The problem of dealing with conductors carrying one to two thousand amperes was a simple one, but when the current to be dealt with ran into the tens of thousands, they could not solve the problem by simply multiplying the cross-sectional area of the conductors. The factor of self-inductance, which might be negligible when dealing with small currents, became of such importance when dealing with very large currents, that it might easily completely outweigh almost all other considerations. He noted that the author stated there was a limit to the size of furnace transformers that could be built, and it would appear, therefore, that if provision had to be made for dealing with a very large output from furnace transformers, it would be necessary to have several banks of transformers with their own furnaces, and he asked the author to state what would be the best lay-out for electrical furnaces and transformers to deal with a large output, more particularly with regard to the disturbance which would be caused to the supply mains if several banks of furnace transformers were to be switched in simultaneously. Even if some kind of electrical interlock could be arranged between the oil switches controlling the various banks of transformers, there always appeared to be a danger of current rushes taking place simultaneously in several banks of transformers during the melting period. The same effect on the supply mains would be produced by furnace transformers in different works in the same district switching in simultaneously, and the effect on the supply mains and generating plant might be very serious.

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Mr. Thomson, in his reply, said Mr. Mitchell's point on reactances would depend on the type of furnace. There were several types, each of which required special treatment. As to variable reactance, the booster in itself had a certain amount of reactance, and when short circuited it was a kind of reactance coil of low reactance value. With reference to tappings, in general it was found that the customer wanted the cheapest possible job. If he got the furnace to work with an equipment which cost £2,000 he would not pay £2,500. He did not see that it would always be possible to have these furnaces near large power stations unless it was impossible to transmit power at a high voltage. When he said 8,000 K.V.A. he did not suggest that that power should go into one unit. Internally choked insulation was generally due to heavy overload on the transformer for long periods. The ventilation of the winding was certainly essential, and the more ventilation they had the longer would be the life of the transformer. He agreed with Mr. Robertson that the switch-gear should be strong and positive in action. The working of smaller units in parallel would be more beneficial, would possibly give a greater reliability of supply, and the makers would not mind because they would get a bigger share of the cost. He could not give the figures asked for by Mr. Sichel at the moment, but the regulation was much higher on the furnace than on the power transformer. As to bare copper conductors and sludge, he had said that bare copper conductors tended to sludge the oil, but that tinned copper conductors did not. Mr. Sichel agreed that the lay-out of large furnaces could not be taken from small furnaces and multiplied. Each individual case must be thought out, and the best possible arrangement adopted. With regard to equipment and method of starting up in the case of batteries of furnaces, in most of such cases the starting period did not coincide, and the labour was reduced by staggering the starting times. It all depended on the size of ingot the customer wished to get. He thought the weight of an 8,000 K.V.A. transformer would be about 30 tons, but he did not agree to 8,000 K.V.A. transformers. He would have smaller units in parallel so that the weight would not be more than about 8½ tons, which would be easily handled by a hand-operated crane.

THE MICROSCOPE IN THE ENGINEERING INDUSTRIES.

The symposium and general discussion on "The Microscope: Its Design, Construction, and Application," which was held in the rooms of the Royal Society on the afternoon and evening of January 14th, was a function of first rate importance, and it will probably prove to be a landmark in the industry and application of one of the most important branches of optical science, so far as concerns British practice. The meeting—due to the initiative of Sir Robert Hadfield, who presided—was organised by a Joint Committee of the Faraday, Royal Microscopical, Optical, and Photomicrographic Societies, and of the Optical Committee of the British Science Guild. Some 40 papers were read or presented, and during the afternoon an exhibition was held which illustrated the development of the British microscope, the new types of standardised or special research instruments now being placed in the market by English makers, many devices and adaptations designed to fit the instrument for particular uses, of which methods of illumination call for special mention, and finally a large number of exhibits, impressive in their cumulative effect, illustrating recent applications of the instrument in the various sciences and industries, including metallography and metallurgy, engineering, physical and bio-chemistry, the textile industries, paper making, food preparations, and the manufacture of drugs.

The subjects discussed readily fell into some three or four groups. It is only possible to indicate here quite briefly the opinions put forward, and the general conclusions reached. The full Report of the proceedings, when it appears, will call for the close consideration not only of physicists and opticians directly interested in the subject, but also of engineers and manufacturers generally, to some of whom the possibilities of microscopy will, perhaps, come as a revelation.

On the general design and the future of the instrument important contributions were made by Mr. J. E. Barnard, President of the Royal Microscopical Society, and by Prof. F. J. Cheshire, President of the Optical Society, and Prof. A. E. Conrady, who are jointly responsible for the Department of Technical Optics at South Kensington. In the mechanical design of the microscope, perhaps, the most important consideration is rigidity. In this respect we can learn much from some of the early English models, but the great desideratum is to regard the subject from the engineering angle rather than from the scientific instrument standpoint. The matter is further complicated by the necessity for mass-production, without which the industry cannot economically be carried on. Mr. Barnard gave the key to the solution of the mechanical problem, when he said that what the maker must aim at is something of the optical bench type, stiff, strong, simple, and easy of adjustment. The latter requirement—the coarse and fine adjustment—is one that has given considerable trouble, and this particularly in the type of microscope of interest to the engineer, who wants to be able to place on the stage and move a heavy weight of metal without straining the instrument. These and analogous difficulties are now being realised and met, and the instruments described and exhibited by Mr. Conrad Beck, Mr. Watson Baker, Mr. Powell Swift, and Messrs. Watson & Sons, and such a microscope as Dr. W. Rosenhain's design, go far to meet present-day requirements.

Prof. C. H. Desch and others remarked on the fact that not sufficient use was being made of some of the modern extremely hard non-ferrous alloys which are far more durable than brass for an instrument of precision like the microscope, that is calling for constant wear and tear in the adjustable parts.

Much attention was given to the matter of illumination, and as the source, the "Pointolite" lamp—a tungsten arc *in vacuo*—was generally admitted to be the most satisfactory for high illumination, although for some purposes a larger area of source is desirable. In a new illuminator exhibited, suitable for metallographical work, an annular electric lamp surrounds the objective, and clearer images are claimed than with the vertical illuminator. For both transparent and opaque objects the mercury vapour lamp was favoured, and this has the advantage of emitting light of small wave length, favourable for increased resolving power.

Round this important question of resolving power much discussion centered, but the subject is somewhat beyond our scope, except to say that progress is to be sought either in the discovery of some artificial or natural crystal, such as fluorite (a specimen of which was shown) of high refractive index, from which objectives could be made, or else in the employment of ultra-violet light, or even light of still higher frequency. In the latter direction some results of extraordinary interest have recently been obtained by Mr. Barnard in elucidating the minute structure of bacteria, and the results of their application to metallography are keenly awaited, for they are likely to teach us much concerning the action of mechanical work on metals, and similar operations which improve physical quality by increasing the fineness of grain-structure. In the meantime, we were shown some record magnifications, up to 8,000, of steel sections, by Sir Robert Hadfield and Mr. T. G. Elliott. Magnification, of course, is not resolution, but, nevertheless, in bringing out the detailed structure of the pearlite in the specimens examined, results of considerable interest were achieved.

The relative virtues of achromatic and apochromatic objectives for high-power work must not detain us now. It was decidedly surprising to hear of the favour given to the former in many quarters, on account of the flatter field which they give.

This sketch of the symposium can fitly conclude with a brief reference to a very useful paper by Mr. S. Whyte on the "Use of the Microscope in Engineering Works." The first use is in the examination of raw materials, such as stampings, in which flaws like incipient cracks or laps of oxide cannot otherwise be detected. A more general use is in arriving at the best heat-treatment temperatures for high-speed steels. It is useless to buy expensive high-grade steel alloys, unless the optimum use be made of them, and this cannot be properly ensured unless the steel be micro-examined after hardening. Another direction in which the microscope can be invaluable to the engineer is in helping to locate causes of failures, for example, the inclusion of slag, of a point of weak design, or a file mark, all of which may set up "fatigue" fractures, and to discover the processes by which these failures develop. Some excellent photomicrographs accompanied this paper of Mr. Whyte's, and added much to its usefulness and suggestiveness.

Electrical Trades Benevolent Institution.—The Cardiff Local Advisory Committee, consisting of Messrs. W. A. Chamen, M.I.E.E. (South Wales Power Co.), R. Howard Fletcher, M.I.E.E. (consulting engineer), W. E. Hobbs (General Electric Co., Ltd.), J. P. MacTaggart (English Electric Co.), and A. McWhirter, M.I.E.E. (President of Cardiff Contractors' Association), are making a determined attempt to secure additional members for this Institution. A meeting was held in the new offices of the G.E.C., at Cardiff, which were kindly lent by the directors for the occasion. The Committee realised the difficulty of getting the younger members of the industry to attend a meeting with the object of getting new members by "speech-making," but a good attendance and considerable success were obtained by arranging a concert, and during the interval Mr. Chamen, in a few remarks, brought home to those present the necessity of supporting the Benevolent Institution. Three of the staff of local companies have offered to act as collectors in their respective firms, and it is expected that some 25 to 30 new recruits will be obtained. A collection was taken, which yielded good results. Cardiff Committee is fortunate in having such good musical talent available without calling on anyone outside the electrical industry. The first half of the programme was given by members of different firms, whilst the second part was provided entirely by the G.E.C. "Magnet" Concert Party. A unanimous wish was expressed for another such gathering to be held in the autumn.

Chemistry and the War.—Prof. Francis, the Dean of the Faculty of Chemistry in Bristol University, addressing the Rotarian Club on Monday, said that the ammonia future of Europe lay with Germany, who was in a position to supply essential fertilisers to the whole of Europe. The safety of our Empire depended on our establishing an industry such as Germany's. It would take us a generation to compete on even terms with the German chemical industry. Our research and industry must be fostered, as success would be to the country with the largest supply of highly trained chemists.—*The Times.*

BUSINESS NOTES.

French Company Notes.—To carry on the electric lamp and heating apparatus business, styled "Halle aux Lampes et Chaleur Electrique," at 17, Rue Dieu, Paris, MM. Brianne et Andoux have formed themselves into a company, with a capital of 185,000 fr.

The Société Auxiliaire du Gaz et de l'Electricité has been established at Paris: capital, 185,000 fr.

For the manufacture of electrical apparatus of all kinds, Théory et Cie has been established as a company at Paris, with a capital of 900,000 fr.

Lançon et Cie is the title of a company formed at Paris, with a capital of 50,000 fr., for the manufacture and repair of electric material.

The Société de Production et de Distribution d'Energie, formerly called the Electricité de Reims, has raised its capital from 4,000,000 fr. to 10,000,000 fr., and issued, besides, 6,000,000 fr. of 6 per cent. bonds, repayable in 25 years from 1927.

The Société Hydro-Electrique de la Haute-Bourne has reduced its capital from 1,000,000 fr. to 500,000 fr. Its second station at Goule-Noir, of 3,000 H.P. capacity, is advancing towards completion.

The Secteur de la Rive Gauche de Paris company has decided to reduce its capital from 9,000,000 to 3,000,000 fr., and to increase it by 600,000 fr. by the issue of new shares. This company recently took part in the re-arrangement of the Paris supply by agreements with the Union de Electricité and other Paris companies.

At the last meeting of the Etablissements P. Godot et Ch. Tournaire, the liquidation of the company was decided upon, but since then it has been decided to reorganise the concern and resume business.

L'Appareillage Electrique Industriel (Ch. Cheveau et Cie) are raising their capital from 300,000 to 500,000 fr.

A Trade Commissioner on Advertising.—The views of H.M. Senior Trade Commissioner in South Africa (Mr. Wickham) on publicity and advertising in South Africa, are published in the *Board of Trade Journal* for February 26th. Among other things, he says that the outlay on advertising should never be based on existing sales, but on potential sales. "Advertising to produce future sales is in the nature of capital expenditure. To keep the cost of advertising strictly within the bounds of what the existing turnover will bear, to expect to pay for it out of the profits on present sales, is to miss the whole point and aim of advertising. Estimate the value and profits of the turnover which it is hoped may be secured in that market, and then calculate on that basis what outlay on advertising can be afforded. It will not infrequently involve spending more for a year or two on a market."

Calendars.—We have received from the British Thomson-Houston Co., Ltd., of Rugby, one of their large sheet calendars for 1920. There are 12 large monthly sheets, on each of which the dates of the preceding and following months are printed in smaller form. Each sheet has particulars of the company's branch offices, a view of the works, and illustrations of B.T.H. manufactures.

The Star Electrical Engineering and Manufacturing Co., Ltd., of 134, Victoria Street, Grimsby, have sent us a wall calendar, with monthly date slips beneath a coloured picture of a maiden seated, by moonlight alone, in pleasant reflective and anticipatory mood.

Electrolytic Ore Treatment in France.—As a result of the report of the mission sent to the U.S.A. to study the electrolytic treatment of zinc ores at Anaconda, the Société de Penarroza has decided to erect a factory in France to utilise this method. Mixed ores containing lead and zinc will be used, and a zinc works and lead works will be established.—*Economic Review.*

Staff Dinner.—A staff dinner was held at Pinoli's Restaurant, on February 26th, to celebrate the twenty-fifth anniversary of Messrs. Evershed & Vignoles, Ltd. Over 90 members of the staff participated, with Mr. Vignoles in the chair. The guests of the evening were Messrs. Vignoles, Vines, and Gregory, all directors of the company. Considerable enthusiasm was displayed at this reunion after five years of war. Mr. Vignoles, in his reply to the toast of "Our Guests and the Firm," proposed by Mr. Shepherd, welcomed the members of the staff who had returned to the firm after their period of service with the Forces. He outlined the history of the firm from the early days of its career. Mr. Vines, who also replied to the toast, thanked the staff for their loyalty, and prophesied continued success and increased prosperity to the company. The toast, "The Committee," was proposed by Mr. Sparrow and replied to by Mr. Short. A concert, under the direction of Mr. Blundell, followed the dinner, and numerous items were rendered by members of the staff.

A Manchester Century.—Messrs. Thomas Hudson's executors, of Manchester, who are hardware merchants, but who are also doing a large wholesale trade in electrical material, completed a century of business last week. The event was commemorated by paying each member of the staff a month's remuneration in place of the usual weekly amount on Friday last.

Liquidations.—Bonecourt Surface Combustion, Ltd.—Meeting called for March 30th, at Parliament Mansions, Victoria Street, S.W., to hear an account of the winding-up from the liquidator, Mr. E. J. Pilcher.

Cosmos Consolidated, Ltd.—Meeting of creditors, Friday, March 12th, at 4B, Frederick's Place, Old Jewry, E.C. 2.

Catalogues Wanted.—H.M. Consul at Liége has organised a Special Catalogue and Sample Exhibition Room at the Consulate offices, and is anxious to receive from British manufacturers and others interested, all publicity matter connected with their products. Catalogues of fittings and accessories suitable for the heavy industries of the Meuse Valley, the coal mines, leather and woollen industries of Verviers, are specially mentioned.

A similar catalogue and sample room will shortly be opened at Charleroi.

Reunions and Socials.—The employés of the Woking Electric Supply Co., Ltd., were entertained on February 20th at a dinner given by the directors at the Popular Restaurant, Woking. The chair was taken by Mr. E. G. Nicholson, the secretary of the company, supported by Mr. F. Woods, the resident engineer, and Mr. A. McIntosh, mains and meter superintendent. Over 50 sat down. A first-class entertainment was provided by Mr. E. H. Gregson. During the evening, the chairman proposed the toast of "The Directors and Company," and reminded those present that it was the first occasion on which the employés of the Woking Electric Supply Co. had ever met together at any social function. It was not a good thing, he said, for the various sections of the company to carry on their duties each practically oblivious of the others. The company had been in existence as an electricity supply concern since 1889, and was, therefore, among the oldest of its kind in this country or the world. The total revenue in 1900, the earliest date of which there were available records, was £4,000, and if they multiplied that amount by 10, they would get the approximate revenue of the company for 1919. Mr. F. Woods, in responding, paid a tribute to the loyalty of the employés. The toast of "The Returned Service Men," was proposed by Mr. A. McIntosh. Of those now in the company's employ, no less than 42 per cent. had served in H.M. Forces during the war. Mr. G. Gore responded for the Navy, and Mr. S. Ashley for the Army. The latter expressed thanks to the company on behalf of his colleagues and himself for the help given to their dependents during their absence. Mr. A. M. Dallen responded on behalf of the Air Force.

A reunion of the Edinburgh, Glasgow, and Dundee staff of Wood & Cairns, Ltd., wholesale electrical factors, was held in the Windsor Rooms, Hillside Crescent, Edinburgh, on Saturday, February 21st. All the directors were present, and after a successful whist drive, the company sat down to dinner, finishing off the evening with dancing.

On February 21st, at the Stationers' Hall, Mr. and Mrs. Howard Marryat entertained a very happy party, consisting of employés of Marryat & Place with their wives, to the number of about 240, "to welcome our soldiers home." The toast of "Our Soldiers," was put from the chair by Mr. Marryat in suitable terms, and replied to by Lieut. C. G. Gwinnell. Mr. Huddle, an old employé, in a witty speech, proposed "The Firm." Miss Carrie Herwin and Mr. Edward Halland, who contributed to the musical programme, were greatly appreciated. Mr. Huddle, in the course of his speech, said that persons in his position were usually expected to whitewash the "bosses," but he could truthfully say of Mr. Marryat that he did not require whitewashing. He gave an interesting account of the firm's expansion from its single office at 57, Hatton Garden. He had seen many changes during 28 years. He believed he installed for the firm one of the first motors in London. It was in the neighbourhood of Hatton Garden. He remembered wiring the offices at present occupied at 28 Hatton Garden. The firm was on a much larger scale now. It had branched out from 57 to its offices at 28, Hatton Garden. There was the lift department at 57A, and the works at Shepherd's Bush, and, during the war, another works had been started in Hatton Garden, of which Mr. Dewhurst had charge. The lift work was now being carried on by Marryat & Scott, and that department was making rapid strides. For their lift safety devices there was a big field, and he looked forward to the day when the lift department would be able to give a dinner like that one.

Copper and Lead Prices.—Messrs. F. Smith & Co. and Messrs. James & Shakespeare report, March 2nd:—"No change in prices quoted last week."

Wages and Working Conditions of London Electricians.—We are glad to publish the following letter from Mr. Leonard G. Tate, general secretary of the National Federated Electrical Association, which indicates that at last the Federation and the E.T.U. have composed their differences:—

"Agreement has now been arrived at as between the London members of the National Federated Electrical Association and the London District Committee of the Electrical Trades Union as to rates and working conditions.

"The agreement, which was signed by both parties on Friday, the 27th ult., makes the rate now payable to a fully qualified electrician 2s. 3d. per hour, and assistant over 21, 1s. 9d. per hour; the men to get from home to job and from job to their homes in their own time, if the job is within the agreed-upon area—namely, 12 miles from Charing Cross, and within 12 miles of the employer's office.

"A Joint Committee has been set up to adjudicate on any disputes that might arise as between the parties, also as to the interpretation of the rules, and to consider, for submission to the parties, any further rules that might be suggested.

The signing of this agreement will, it is hoped, do away with the friction that has existed for many years between the members of the E.T.U. and their contractor-employers."

Bankruptcy Proceedings.—Walter Henry Mellon (late trading as H. B. Wallis & Co.), electrical engineer, 37, Elliott Road, Chiswick, late 43, Turnham Green Terrace, Chiswick, Middlesex.—This debtor came up for his public examination on February 24th, at Brentford, before Mr. Registrar Sills. He said that his liabilities were £384 and his assets £155. For some years he was a comedian, earning £3 to £4 a-week, but he took up with electricity, and commenced business in Charndon Road, Chiswick, with £50 which he had saved. In June, 1917, in partnership with Mr. W. R. Vallance, he took 43, Turnham Green Terrace, as H. B. Wallis & Co., each partner putting £50 into the concern; he was to draw £1 or £2 a week and have a share of the profits: his partner only took a share of the profits. Another shop, 49, Turnham Green Terrace, was taken, but afterwards it was taken over by Mr. Vallance, as he could not manage both. His health was bad, and this caused him to neglect business, which was the cause of his failure. The hearing was adjourned.

Re W. H. Howard, electrical engineer, lately carrying on business as The Holborn Electrical Co., 5, Featherstone Buildings, Holborn.—An application for an order of discharge was made on February 27th, at the London Bankrupty Court, by this bankrupt, who failed in November, 1911. Mr. D. Williams, Official Receiver, reported that the applicant commenced business without capital, in 1900, with another person, at 60, Red Lion Street, Holborn. The partner retired three years later, and the bankrupt continued the business alone, both as "The Holborn Electrical Co." and as "Howard & Co.," and taking premises successively at 18, Red Lion Street, 49, Lamb's Conduit Street, 1, New Oxford Street, 5, Featherstone Buildings, 64, Red Lion Street, and again at 5, Featherstone Buildings. When he left each of the said premises rent was owing, and was not afterwards paid. Three years before the bankruptcy the applicant sued the landlord of 1, New Oxford Street for damages and trespass in connection with repairs to the roof of the building, but judgment was given in favour of the landlord. During the action, the business fell away, as the bankrupt was unable to give it proper attention, and he closed it down in April, 1911, since which date he had been employed as a canvasser for an electrical supply company. In 1909 his solicitor obtained judgment for the costs of the action, and in May, 1911, obtained an order for payment of the bill by monthly instalments of £2; the bankrupt was unable to keep up the payments, and to escape committal to prison for default, he filed his petition. The liabilities amounted to £560, and no assets were disclosed or recovered. The bankrupt attributed his failure and insolvency to want of capital, general falling away of business during the last three years of his trading owing to competition by electrical supply authorities; also to the adverse result of the before-mentioned action and consequent liability for costs. The offences reported by the Official Receiver were (1) insufficiency of assets to equal 10s. in the £ on the amount of the liabilities; (2) omission to keep proper books of account; and (3) trading with knowledge of insolvency. Mr. Registrar Francke upheld the report, and imposed a suspension of two years, remarking that if the bankrupt had applied earlier, he would have been free a long time since.

46½-Hour Week for Berlin Metal Workers.—The *Economic Review*, quoting *Deut. Allg. Ztg.*, states that the Union of Berlin Metal Manufacturers, in granting the extra wages and bonuses to their employés, proposed that the workers, on their side, should pledge themselves to a net working week of 46½ hours, including those factories where at present the working hours are less than this. The Metal Workers' Union agreed that the question should be referred to an impartial arbitration court, whose award should be binding on both parties. The Court decided in favour of the 46½-hour week.

Lead.—Messrs. James Forster & Co. report (February 28th):—

> We have to record a drop of about 15s. per ton on the week, but in the absence of any likelihood of an increase in imports in the near future, we can scarcely look for any substantial decline in values. Controlled lead has not been on offer for some weeks past, and in view of the fact that nearly all the metal in Government stores has already been disposed of, for delivery spread over the next few months, assistance from this quarter cannot be relied upon.

Messrs. G. Cawson & Co. say:—

> There is a good deal of talk of using substitutes for lead, and no doubt something will be done in this direction which will tend to influence the consumption unfavourably. Meanwhile supplies continue abundant, and lead is regularly going into store—so that although Government stocks are being gradually reduced, private stocks are steadily increasing; no actual figures, however, are obtainable. France seems to be arranging to cut herself adrift from other countries, and to become self-supporting for her lead supplies. If she eventually manages to do this, it will make a great difference in the demand in this country. Reports from America continue favourable, and prices there seem to be well maintained. The position in Mexico, however, is gradually improving, and we can now look with more confidence for a steady increase in supply from that country.

German Engineering Industry: Reported Critical Situation.—According to resolutions which have just been adopted at a general meeting of the Association of German Machinery Construction Works, held in Berlin, this industry is confronted with the solution of exceptionally difficult conditions as a result of the development of circumstances during the past 15 months. On the one hand, the makers are severely hit by the increases in the prices of raw and semi-finished materials which they use in the production of machinery, while, on the other, they are frequently bound to execute old orders which were accepted at fixed prices, and which were undertaken in the early period after the revolution. The enormous rise in the prices of materials, combined with the long period required for effecting delivery, has placed the industry in an extremely difficult situation. The Association mentions that the industry, with a turnover of many milliards of marks, finds employment for about 1,000,000 workmen and staff. As a result of the great economic importance of the industry, the makers expect reasonable consideration on the part of the suppliers of raw and semi-finished materials in the matter of future prices, and due judgment on the part of customers in regard to the prices and other conditions of delivery required by the machinery makers. It is considered that the industry, dependent upon syndicates for the delivery of materials for conversion into finished machinery, cannot exist unless supplementary additions are made to the prices fixed in the old contracts and unless reserves are made in the prices for new orders with an extended period for delivery. The Association submits that official circles must also understand these facts. An urgent request has been addressed to the Government asking that the exports of machinery, which have scarcely been resumed, should not be jeopardised by the levying of duties on machinery sent to other countries.—*Financial Times.*

Mather & Platt, Ltd.—Foreign Trade.—In the course of his speech at the annual meeting of Mather & Platt, Ltd, the chairman, Mr. Loris E. Mather, said he had recently returned from a three months' visit to the United States. He visited many engineering concerns, and was able to study many methods there which might be usefully employed on this side. They had at Park Works a plant, for its size, as well designed and as up-to-date as any to be found across the Atlantic. During the year they had brought into use the four additional bays given over to aeroplane manufacture, the benefit of which would only be felt this year. Considerable further extensions were in progress, which they hoped to have completed and in occupation by the end of this year. The trade prospects abroad were encouraging, in spite of fluctuating exchanges, difficulties in shipment, and the impaired purchasing power of countries which had suffered from the war. They had always had extensive and close trade connections with France, and at the outbreak of war they had large amounts owing from French clients. It was most gratifying to be able to state that the misfortunes of war had not prevented their French clients from meeting to the full these liabilities. Their business in Russia had suffered temporary eclipse, and they had incurred heavy losses which had been provided for in the accounts, but it was right to add that the probity of their clients had been unquestioned, and losses were due to the extinction of government in Russia, and collapse of Russian exchange. They were already resuming business in Poland. It would be the settled policy of the board to help their old and trusted clients abroad to restore their pre-war producing power. It was only by restoration of the producing power of all countries that trade could regain its old prosperity, and they meant, so far as they prudently could, to take their due share in helping towards this end. The abounding prosperity of India and the removal of restrictions of various kinds had brought about a remarkable increase in the volume of orders they were receiving from that country. One of their directors had recently been in India: another was now in the Far East, where big developments were taking place. They must, however, always look to the home trade as having the first claim upon them, and here there was a large volume of work already placed upon their order books. One of their greatest difficulties this year would be to satisfy their customers at home and abroad in giving them deliveries in reasonable time. They could not obtain the materials needed in their manufactures as quickly as they would like, due to the heavy demand on all sides and delays caused by strikes, but they were doing their utmost.

Claiming Pre-war Debts.—Some notes have been prepared by the Clearing Office for the assistance of British creditors in filling up their forms of proof. Copies of the notes may be had on application to the Controller, Clearing Office (Enemy Debts), Cornwall House, S.E. 1.

Canadian Electrical Union Demands.—According to the *Electrical News* (Canada), representatives of unions of the various electrical workers organisations met in Toronto recently and prepared a programme of demands which, it is understood, they will present to the Provincial Government. These demands include a licensing system for both contractors and workers; a uniform wage for the province; certain changes in the installation of distributing systems; certain amendments to the Workmen's Compensation Act and representation upon provincial and municipal hydro-electric commissions. It is proposed to inaugurate a licensing system under which employés shall serve a four-year apprenticeship before they receive a certificate of qualification and become regular journeymen.

Trade Announcements.—Mr. Wm. Carr has commenced business as an electrical engineer at 35, Marshall Avenue, Bridlington.

Mr. W. J. Cannon, electrical engineer and contractor, has opened new show-room premises at 8, Dalby Road, Cliftonville, Margate.

Mr. L. O. Heyes has retired from the firm of Heyes & Co., electrical engineers, of Douglas Side, Wigan, and the business will be continued by Mr. W. A. Heyes.

Messrs. H. W. Jones, Ltd., electrical engineers, of Eccles, Lancs., have removed to new premises at Monton Road, Monton.

Mr. F. Stanford has resigned his appointment with Messrs. Stegman & Co., with whom he has been for 25 years. He has opened up business as an electrical engineer at 5, Crieff Road, Wandsworth, S.W. 18.

The Warrington Electrical Co., Ltd., have changed their address to Knutsford Road Works, Warrington. Telegrams: "Power, Warrington."

Mr. W. G. Perry has resigned his position as power engineer with the South London Electric Supply Corporation, Ltd., and has started in business at 199, Westminster Bridge Road, S.E. 1, under the style of W. G. Perry & Co., Ltd., electrical contractors.

Book Notices.—"Five-figure Logarithms and Trigonometrical Functions." Price 1s. 6d. net. "Mathematical Tables." Price 4s. 6d. net. By W. E. Dommett and H. C. Herd. London: J. Selwyn & Co., Ltd.

"Science Abstracts, A and B." Vol. XXIII, Part 1, No. 265. January 13th, 1920. London: E. & F. N. Spon, Ltd. Price 2s. 3d. each.

"Memorandum on Solid Lubricants." *Bulletin* No. 4 of the Department of Scientific and Industrial Research (28 pp.). London: H.M. Stationery Office. Price 6d. net.—Contains much useful information regarding the nature and application of such substances as graphite, white lead, soapstone, &c.

Circular No. 83 of the U.S. Bureau of Standards, "Specifications for the Manufacture and Installation of Railroad Track Scales." (35 pp.). Washington: Government Printing Office. Price 5 cents.—The object of this publication is to provide railroad engineers with data to enable them to secure scales adequate to meet modern requirements.

"Quin's Metal Handbook and Statistics," 1920. London: Metal Information Bureau, Ltd. 3s. 6d. net, post free. This is the seventh year of publication of what is a very useful book, in which are tabulated statistics and 1919 price records of copper, tin, spelter, lead, silver, antimony, arsenic, nickel, and iron and steel. Among other features, we notice a list of the licensees under the non-Ferrous Metals Act.

"The Examination of Materials by X-Rays." Reprinted from the *Transactions* of the Faraday Society. London: The Society. Price 12s. 6d.

"*Proceedings* of the Physical Society of London." Vol. XXXII, Part II, February 15th, 1919. London: Fleetway Press, Ltd. Price 4s. net.

The Rubber Age (published monthly). No. 1. March, 1920. London: 43, Essex Street, Strand. Price 1s.

Plant, &c., for Sale.—Slough and Datchet Electric Supply Co., Ltd., has for disposal one three-crank compound Davey, Paxman engine direct coupled to two Siemens D.C. generators, and two switchboard panels; Colne Corporation Electricity Department invites offers for a Green's economiser and a 2-H.P. driving motor; Messrs. Campbell & Lamond have for disposal premises suitable for joinery or other works requiring extensive floor space, situated at Calder Green, Renfrewshire. For particulars see our advertisement pages to-day.

Catalogues and Lists.—Messrs. James M'Millan & Co. (formerly the Ericsson-Bell Telephone Co.), Clun House, Surrey Street, Strand, W.C. 2, sole agents of the Elektrisk Bureau, Ltd., of Christiania, Norway.—Lists Sections I to VI inclusive. Section I is devoted to magneto telephones and also special instruments for mining, diving, and high-tension work; Section II presents a series of central-battery telephones; Section III deals mainly with intercommunication sets; Section IV—portable sets—includes a four-line artillery telephone; switchboards and accessories are dealt with in Section V, and the last list is a general catalogue of parts and accessories. The lists are profusely illustrated, and cover a wide range.

The Rockingham Engineering Co., Beulah Road, Thornton Heath, S.E.—Leaflet giving illustrations, details, and prices of electric organ-blowing sets.

Messrs. J. Hopkinson & Co., Ltd., Britannia Works, Huddersfield.—Catalogue 800, 398 pp. An extremely useful and comprehensive list of all classes of boiler gear. It is divided into 13 sections, and is illustrated by numerous photographs and line drawings. The first section presents information regarding materials and specifications. Then follow divisions dealing with mountings, safety valves, high and low pressure valves for steam, water, and air; boiler-feed and check valves and injectors; blow-off valves and pipes; water gauges and fusible plugs; pressure gauges, siphons, and cocks; isolating valves, reducing and surplus valves, expansion joints, steam dryers and traps and automatic exhaust valves, cocks, whistles, thermometers, &c. The catalogue concludes with a complete index of contents and code words.

Messrs. Greenwood & Batley, Ltd., Donington House, Norfolk Street, Strand, W.C. 2.—Leaflets Nos. 53, 54, 55, 56, and 60. Illustrated price-lists of "Bipol" accumulator batteries for motor-cycle lighting, lanterns, &c.

Mada Engineering Co., Ltd., 12, Bevington Hill, Liverpool.—Illustrated leaflet (8 pp) dealing with the "Remca" patent electric riveter.

The General Electric Co., Ltd., 67, Queen Victoria Street, E.C. 4.—New "Osram" billheads (or invoice forms) and postcards. The G.E. Co. states that it will be pleased to supply quantities of these, overprinted with name and address, to members of the trade. "Conveying and Transporting Machinery" (74 pp). This publication, printed on art paper and profusely illustrated by photographs, indicates the wide field covered by Fraser & Chalmers conveyors, &c. The first part describes belt conveyors, pulleys, and idlers. Then shipping plants are dealt with, and photographs of actual installations are given. The Fraser & Chalmers coal-handling plant at Durban is fully described, and photographs of the boiler-house conveyor at Marylebone and the Brancepeth Colliery conveying plant are presented. Grabs and grab transporters are given several pages, and the photographs include three of the transporters built for the Admiralty.

H. C. Slingsby, 142, 144 and 146, Old Street, E.C.—List No. 153. An eight-paged booklet illustrating and describing steel-back extension ladders, with details of tests. Also tower ladders, ladder carriers, and step ladders.

The India-rubber, Gutta-percha, and Telegraph Works Co., Ltd., Silvertown, E. 16.—Illustrated leaflet dealing with "Silvertown" dry and inert cells.

Building Products, Ltd., Columbia House, 44-46, King's Road, Sloane Square, S.W. 3.—Booklet (16 pp.) dealing with "Bareau," a water-proofing material for cement concrete. Contains details of tests, instructions for use, &c.

Messrs. Higgs Bros., Dynamo Works, Sand Pits, Birmingham.—"Monthly Magazine" for March (20 pp.). The body of this booklet is devoted to a stock list of motors and dynamos. An insurance scheme has been formulated by the firm, and details are given. The remainder of the magazine contains "Hints and Tips" on brushes, and one or two anecdotes truthfully described as "chestnuts."

Messrs. Robinson & Hands Electrical Co., Ltd., 54, Barwick Street, Birmingham, have issued a new illustrated and priced catalogue in conjunction with their exhibit at Castle Bromwich Fair, dealing with electrical accessories, the four main lines being lampholders, fuseboards, tumbler switches, and accumulator switchboards, all of which are of British make throughout.

Leoline Edwards, 81, St. Margaret's Road, Twickenham.—Leaflets describing "Quidos" electric lamp bed foot-warmer and food-warmer and portable fireproof safes.

A French Supply Combination.—A scheme for the electrical transmission of power from the Alps to the district of Lyons has been inaugurated by the formation of a combination of 10 existing companies, under the title of the Société de Transport d'Energie des Alps, of 49, Rue de la Bourse, Lyons, with a provisional share capital of 2,000,000 fr. The representatives of the 10 companies form the first board of directors.

LIGHTING AND POWER NOTES.

Aberdeen.—Extensions.—On the recommendation of Mr. J. H. Rider, the Dee Village Works are to be extended, and for this purpose power is being sought to acquire new property.

Balla (Co. Mayo).—Lighting Scheme.—It has been decided to install electric lighting by a private scheme, and Mr. McEllen has applied to the County Council for the necessary permission.

Barnstaple. — Proposed Extensions. — The Town Council has appointed Mr. J. S. Highfield to prepare a report on the undertaking, in order that extensions to meet the greatly increased demands may be carried out. Applications from prospective consumers are constantly being received, but the load is already at the maximum. Electric lighting is to be installed in the buildings being erected under the Barnstaple housing scheme.

Barrow.—Loan.—The Electricity Commissioners are to be asked by the Town Council for sanction to borrow £35,000 for electricity works purposes. This includes £8,451 for anticipated extensions, £5,000 for transformers and switchgear, and for over-expenditure on previous loans.

Bedford.—Increased Revenue.—The Town Council has received applications for supplies of electricity which will bring in an additional revenue of £5,000 a year.

Bradford.—Repaired Turbine.—After being out of commission for a long time, in consequence of the breakdown during the latter part of last year, the large turbine has again commenced to run, the repairs having been completed.

Braintree.—Electric Lighting.—The East Anglian Electricity Co. has prepared an electric lighting scheme for the town, and a petition in favour of its adoption is to be presented to the Urban District Council.

Chelmsford.—Return to Gas.—Chelmsford is in future to have gas for street lighting, the Town Council having refused to renew the contract with the Electric Lighting Co., as gas produced at the municipal gas works will be cheaper. Chelmsford was the first town in England to use electricity for public lighting.—*Daily Mail.*

Chester.—Industrial Development.—With a view to providing information for those seeking industrial sites, the Mayor has invited the city electrical engineer (Mr. Britton) to draft a scheme for the industrial development of the city and district.

Chesterfield.—Faults.—It was reported to the Electricity Committee that there had been a great many interruptions of the electrical supply. Most of these occurred in the Ashgate Road section, and were attributable, it is believed, to one of the mains having been penetrated by a pick during the re-laying of the Post Office telephone cables.

Continental.—Germany.—It is stated that a conclusion has been reached in connection with the lengthy investigations concerning the canalisation of the River Neckar for the double purpose of providing a great navigable waterway and the utilisation of the water-power. The estimated expenditure on the basis of former peace prices is put at 150,000,000 marks, of which the sum of 35,000,000 marks is intended for the construction of 26 hydro-electric works to yield a total of 50,000 KW.

Derry.—Price Increase.—The Corporation has increased the charge for electric lighting by 50 per cent.

Dublin.—Stock.—The Corporation is considering the issue of 3½ per cent. City stock to raise the sum of approximately £69,000 for the purpose of extending the electricity undertaking.

Edinburgh.—Mains Extensions.—The Town Council has approved the recommendations of the Electricity Committee for the laying of cables between Portobello and M'Donald Road, at an estimated cost of £52,000, and the extension of mains to Granton, costing approximately £20,000.

Gillingham.—Extensions.—The report of Mr. C. H. Wordingham upon the electricity undertaking, together with his recommendations, has been adopted, and extensions are to be proceeded with.

Halifax.—Loans.—The Tramways and Electricity Committee has decided to make application for sanction to borrow the following amounts in connection with the electricity undertaking:—Motors, £10,000; transformers, £10,000; and mains, £20,000.

New Plant.—A recommendation has been made by the Corporation electrical engineer for tenders to be placed at once for a 10,000-kw. set, with the necessary condenser, at an estimated cost of £77,800. This will form part of a scheme to cost £170,000, which the Corporation has already approved.

Year's Working.—The recently published accounts for the year ended March 31st, 1919, show in the summary a deficiency of £1,269. The total expenditure was £112,843, against an income of £111,574.

Hemsworth.—Application for Supply.—The District Council is approaching the Yorkshire Electric Power Co. with regard to obtaining a supply of electricity for the district.

Hove.—Bulk Supply.—The Corporation is applying to the Brighton authorities for a statement of terms upon which a bulk supply can be obtained from the Brighton undertaking. When the Hove Corporation took over the private company, which previously supplied the greater part of the district, it intended to extend the plant to meet the demands of the whole area, but owing to circumstances this was not proceeded with, and the present plant is inadequate.

Hull.—Inadequate Supply.—Several large firms in this district have been requested to reduce their demand by 50 per cent., and consequently a large number of men are practically out of work. The reason given is that a heavy lighting load has been experienced owing to the prevalence of thick fogs.

India.—Cauvery Power Undertaking.—The present output of the Sivasamudram station is 21,500 h.p. The mining companies in the Kolar goldfields have, however, recently intimated that their demands will be greatly increased, and it is, therefore, contemplated to extend the plant to a total capacity of 27,000 h.p., with a reserve of 3,600 h.p.

Kingswood. — Electric Lighting. — The Bristol Corporation has agreed to supply electricity to residents of Kingswood subject to an agreed annual minimum payment of £4 for three years. The Urban District Council has consented to this arrangement.

Lancaster. — Proposed Price Increase. — The Town Council has appointed a Sub-Committee to investigate the position of the electricity undertaking with a view to increasing the charges, which are considered inadequate.

Leicester.—New Power Station.—The City Council is to apply to the Electricity Commissioners for sanction to a scheme involving the erection of a power station at Aylestone Road. The cost of the new works, which will have a capacity of 10,000 kw. in the first instance, is estimated at £600,000.

Liverpool.—School Lighting.—After a debate upon the respective merits of gas and electricity, the Education Committed decided to employ electricity for lighting five special schools, although the initial cost will be greater.

London.—The Coal Problem.—A conference of representatives of electricity undertakings in Greater London was held recently to place the following requests before the Coal Controller:—(1) That the rebate to be paid under the Coal (Pit-mouth) Prices Order, 1919, be paid directly by the Controller; (2) that special steps be taken to secure an adequate supply of coal for power stations and other public utility services; (3) that the order relating to acceptance of colliery weights be rescinded and payment made for weights actually received; and (4) that coal be properly graded and charged for according to quality.

St. Pancras.—The Electricity Committee recommends the purchase of two motor converters, together with the necessary mains and switchgear, at an estimated cost of £14,150. Inquiries are to be made with regard to a site for a proposed new sub-station to house these converters. The women employés in the meter repairing department applied for an increase of 5s. per week, which was granted, but at the same time steps are to be taken to replace the female staff by men, preference to be given to disabled ex-service men.

Mexborough.—Mains Extensions.—The Urban District Council has applied for permission to lay cables through the parishes of Denaby and Conisborough, with a view to supplying them with electricity. The Doncaster District Council has referred the matter to the respective parochial Committees for consideration.

Northallerton. — Year's Working. — At the annual meeting of the Electric Light and Power Co. it was announced that the profit for 1919 was £460, as against £342 for the previous year.

Perth.—Electricity Supply.—The Corporation electrical engineer is to lay a temporary cable to supply electricity to residents in Craigie, who recently petitioned the Town Council for a supply.

Preston.—New Station. — It is announced that the building of a large central station at Preston will be commenced next year on the south bank of the Ribble, opposite the entrance to Preston Dock, where a large dam is to be constructed. The output of the station will be sufficient to meet all industrial requirements for a large part of the county.

Salford. — Loan. — The Electricity Committee has recommended application for sanction to the borrowing of £144,344 with which to effect certain developments. The proposed expenditure includes £47,340 for generating plant and £42,000 for boiler-house plant. The feeder mains to sub-stations will cost £19,700.

Stoke-on-Trent. — House Lighting. — The Finance Committee would not approve, on the grounds of excessive cost, a proposal of the Electricity Committee to supply electricity to the Trent Vale housing site.

Sunderland.—Extensions. — The Town Council has adopted the Electricity Committee's scheme for the extension of the undertaking, at an estimated cost of £127,068. Owing to the inadequacy of the present supply, many consumers have been asked to cut down their demands by 10 per cent. The new plant will include two new boilers, a cooling tower, and an additional sub-station. A proposal to make inquiries with a view to obtaining a bulk supply was defeated.

TRAMWAY AND RAILWAY NOTES.

Accrington.—Fares Revision.—The Tramways Committee is considering the whole question of fares on local routes. A communication has been received from the Haslingden Town Council urging the necessity of an increase of fares between the two towns.

Blackpool.—Track Renewals.—The track mileage involved in the permanent way renewal scheme is equal to 18 miles of single track. The borough engineer's estimate of the cost of relaying the permanent way, including the doubling of the line between Dickson Road and the Gynn is £254,343. In addition, £52,177 is proposed to be spent on new works, making a total of £306,520. The proposed reconstruction work will, it is anticipated, be spread over a period of three years. An outlay of £104,620 is estimated for the year ending March, 1921; £105,867 in 1921-22; and £43,856 in 1922-3. The cost of renewing the track is estimated to average £14,274 per mile, as compared with an average cost of £7,322 per mile for the original track.

Continental.—Italy. — The Department of Overseas Trade (Development and Intelligence) states that "His Majesty's Commercial Counsellor at Rome quotes *La Tribune* as stating that the work of the Commission for the electrification of the railways, appointed by the Minister of Transport, is proceeding actively, both as regards the system to be adopted and the continuation of the works in hand in Liguria, Piedmont and part of Lombardy. In these districts the Railways General Management is continuing the electrification on the three-phase system, of the line between Turin and Genoa of about 400 km., and by means of a private undertaking, the lines Turin-Milan and Milan-Voghera for another 200 km., in order to complete, as soon as possible, the principle links of this railway system. With regard to central Italy, a meeting was held recently, under the presidency of the Minister of Transport, of the various public bodies and companies interested in the utilisation of the electric power in the Umbro-Tuscan-Emilian district, in order to co-ordinate available and utilisable power for local requirements and railways. The Commission approved, from the technical point of view, plans for two thermo-electric stations, using national fuel, at Tavernelle di Perugia and Torre del Lago respectively, capable of producing about 20,000 kw. The plans have been commenced for the linking up of Rome and Naples and the Southern Provinces. A programme has also been drawn up for the extension of steam traction by oil fuel for those lines where it will take some time to provide hydro and thermo-electric power, that is to say, largely in Sicily, Calabria, Basilicata and Puglia."

Edinburgh.—Rail Repairs. — The Tramways Committee is utilising a petrol-electric motor workshop for the repair of worn and broken rails by electric welding.

Glasgow.—Extensions and Renewals.—Reports on work in progress and in prospect have been submitted to the respective Departmental Committees of Glasgow Town Council by the officials in charge. So far as the tramways are concerned, the

general manager reports as follows on work in prospect, the figures showing the estimated cost :—

Renewal of Track (£100,000).—This work is at present being proceeded with.

Building 30 New Cars (£30,000).—This work is being carried out as quickly as supplies of materials will permit.

New Car Depôt (exclusive of price of ground, £70,000).—The schedules for this work are in course of preparation.

Tramway Extensions (£600,000).—This subject-matter has been remitted to a Special Sub-Committee, which will report thereon at an early date.

Great Northern Railway.—Parliamentary Bill.—The G.N.R. Bill passed its second reading on March 1st. The Association of Urban District Councils and the Metropolitan Water Board opposed Clause 47 through Parliamentary representatives. This clause will enable the company to purchase gas, electricity and water from any local authority in the vicinity of the railway, and to use such supplies on any portion of the railway or the company's property, whether beyond the area of the supply authorities or not.

Halifax.—Collision.—Through the swerving of a trailer-lorry into a section power-box at the bottom of Pye Nest Park, the supply was cut off on the King Cross section, on February 21st, and much inconvenience was caused.

India.—Electric Railway.—Messrs. Hoare, Millar and Co. have prepared a scheme for a circular railway for Calcutta. The Railway Board has decided that a preliminary investigation into the feasibility of the scheme should be made by a Committee composed of representatives of the Port Trust, the Eastern Bengal Railway, the Calcutta Corporation, and the Government of Bengal, under the chairmanship of a member of the Railway Board.

Keighley.—Reply to Criticisms.—In answer to criticisms levelled at the Corporation tramway service, the chairman of the Committee said that the debt on the undertaking had been reduced by £7,000, and there had been no call made upon the rates by the undertaking, though 22 out of 84 municipalities running tramways had had to do so. The revenue in 1914 was £9,800 ; this year it was hoped to realise £16,500. The foreign firm which guaranteed to maintain the railless trolley vehicles was broken up by the war, and this prevented the overhead equipment scheme being completed.

Liverpool.—Carriage of Parcels.—The tramway manager is to report on a scheme for the conveyance of parcels and goods by tramcar.

London.—Accident.—Owing to motor failure, an L.C.C. tramcar ran backwards down a steep hill near Clapham Common, on February 23rd. At the base of the incline it collided with another car, and both were badly damaged. A woman was killed and four other passengers slightly injured by jumping off the car.

Municipal Tramways.—Finances.—Some interesting figures are given by the *Birmingham Post* showing the position of British municipal tramway undertakings. Statistics compiled by the Municipal Tramways Association show that no less than 20 per cent. of the concerns are running at a loss, the deficit being borne by local rates. It is stated that the extra rate involved was as much as 10d. in the £ at West Ham. Tramways that contributed to the rates prior to the war—such as Belfast, Birmingham, Bradford, and Glasgow—have been compelled to reduce, and in some cases abolish, their aid to local rates. Many others, however, as Leeds, Blackpool, Manchester, and Newcastle-on-Tyne, have been able to increase their contributions.

Plymouth.—Fare Increase.—Fares on all routes are to be increased by 50 per cent.

Stalybridge.—Fare Revision.—The Tramways Committee has informed the Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board that it has been compelled to revise the fares with a view to increasing them, on account of the abnormal increase in working costs. The loss on the tramways last year was £3,000, and, if extra revenue was not collected, it was estimated that the loss next year would be from £10,000 to £11,000.

TELEGRAPH AND TELEPHONE NOTES.

Australia.—The Commonwealth Post Office made a net profit in the last financial year of £524,645, an increase of £137,263 on the working of the previous year. The telegraph department made a profit of £63,133, against £28,116 last year, and the telephone department made a profit of £222,174, against £121,844. The main increase in revenue was derived from the telephone services ; with the exception of Western Australia, where there was a loss of £13,697, against a loss of £25,020 in 1917-18, the telephone branch showed a profit in every State. Victoria stands head and shoulders above the other States with regard to the profitable working of its telephone system. The telephone exchanges in this State for the last financial year showed a profit on the year's working of approximately £60,000, over £18,000 in excess of the profits derived from the same source in South Australia, and more than double the profits earned by the telephone exchanges in New South Wales during the same period. There was a loss on the working of some of the Victorian country exchanges, but as a set off against this the metropolitan network of exchanges with 29,749 subscribers, made a profit for the year of £66,000. The actual revenue for the year from the Melbourne exchange networks was £343,896, but against this had to be written off a sum of £138,166 for direct working expenses, as well as the cost of administrative expenses, depreciation and interest, and a proportion of the cost of pensions and retiring allowances. The Sydney exchanges, which earned the sum of £465,099 during the last financial year from a total of 39,296 subscribers, yielded a net profit on the year's working of only £35,500. Only three States, Victoria, New South Wales and South Australia, showed a profit on the working of the telegraph branch for the past financial year. But the profits earned by these three States were sufficiently in excess of the losses in the three other States to yield a net profit for the Commonwealth as a whole of £63,133. Western Australia showed a loss on the working of all three branches of the postal department.

Eastern Cable Delays.—The Eastern Telegraph Co. announces that owing to the interruption of the British Pacific cable between Australia and Canada and the Commercial Pacific Cable Co.'s cable between the United States and the Far East, all traffic carried by those two routes will now have to pass over the Eastern Co.'s system, and consequently additional delay may be expected.

France.—The Société Radiotechnique de Pologne (Radiopol) is the title of a company formed at Paris for the installation and working (in Poland apparently) of every system of telegraphy, including wireless. Its capital is 6,000,000 marks. Its founders include the Marconi Co., of London ; the Société Française Radioelectrique ; the Compagnie Générale de Télégraphie Sans Fil ; the Compagnie Générale de Radio-télégraphie ; the Société Polonaise de Construction et d'Exploitation des Procédés Radio-techniques ; and the Banque du Commerce et de l'Industrie.

Italy.—A portion of the programme now under consideration for the commercial expansion of Italy abroad, and more particularly in the East, is the establishment of three telephonic lines, namely, a line 2,000 km. long, linking Rome with Constantinople ; a second, from Rome to Otranto, and thence to Valona, Salonica, and Athens, 1,500 km. long ; and a third line from Rome, 2,600 km. in length, to one or more Danubian ports. Arrangements allowing of the use of Bell's multiplex telephone are also mooted. The laying of a second submarine cable from Otranto is also spoken of, the existing one dating so far back as 1850.

New Wireless Service.—A new channel of communication between the Old and New Worlds was opened on March 1st by the inauguration of a direct wireless service for commercial and general purposes, between Great Britain and the United States. This service is being conducted jointly by the English Marconi Co. and the Radio Corporation of America over a route operated entirely by these wireless companies. Messages are being accepted for New York, Greater New York, and South America, up to 4d. less per word than the existing cable charges. The messages are being transmitted on the British side from the high power Marconi station at Carnarvon, which is in direct communication by private wire with the Marconi office in London and the Central Telegraph Office. The Carnarvon station is equipped with high-speed automatic transmitting gear, and the receiving station is arranged for duplex working so that trans-Atlantic messages can be transmitted simultaneously in both directions. The messages are received on the American side of the route at Belmar, New Jersey, which in turn is in direct communication by private wire with the telegraph office of the Radio Corporation in Broadway, New York City.

New Zealand.—Representatives of the newly-formed New Zealand Wireless Institute waited upon the chief engineer of the Post and Telegraph Department, recently to inquire about the prospect of securing licences to enable amateur workers to operate wireless apparatus. New Zealand is still subject to War Regulations in this matter, and the Department is unable at present to grant licences except to ships. A Bill has been prepared to extend the powers of the Department, and will probably be submitted to the next session.

Trades Telephone List Directly.—Tenders are invited by the Postmaster-General, says *The Times*, for the right to publish an authorised classified trades list of telephone subscribers for London, to be issued every six months, beginning next October.

West Indian Cables.—A Committee is to study the question of wireless telegraphy as regards the West Indies, and to inquire into the cable system of that section of the Empire, says the *Times*. An experiment in wireless telegraphy was made some 10 years ago, when British Guiana granted a licence to the West India and Panama Telegraph Co., to establish and maintain a wireless station in that colony for communication with the adjoining island of Trinidad. This arrangement continued until August, 1915, when an Imperial wireless station was set up in British Guiana. Jamaica also possesses her wireless station, and steps were taken last year to allow the stations—controlled by the Admiralty—in Newfoundland, Nova Scotia, Bermuda, Jamaica, and British Guiana to be used for commercial point-to-point messages.

Wireless Telephony.—Successful wireless telephonic tests have been carried out between Madrid and Chelmsford, and conversation was carried on without appreciable difficulty.

An attempt is shortly to be made to speak from Chelmsford to America and Australia by wireless telephony.

On February 29th, for the first time intelligible wireless telephonic messages were received at the Waxholm Wireless Station, 12 miles from Stockholm, from England and Germany. The English message was distinctly audible.

Wireless telephonic messages are transmitted every evening from Chelmsford, at 8 p.m., for experimental purposes, and it is reported that such a message has been picked up by a ship at sea, 600 miles away, with an ordinary commercial receiver. It is requested that the reception of such messages be reported to the Marconi Co., and most of the acknowledgments received give technical observations of considerable value.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Aberdare. — March 20th. Urban District Council. Reconstruction of existing tramways; also new tramways. Mr. E. M. Lacey, 12, Victoria Street, S.W. 1.

Australia.—Melbourne.—April 12th. City Council. Two 2,000-kw. rotary converters; h.t. switchgear, 6,600 v.; d.c. switchgear, 600 v. (January 30th.)

Bedford. — March 31st. Electricity Department. Twelve months' supply of electricity meters and h.t. and l.t. cables. (See this issue.)

Belfast.—March 10th. Electricity Department. Stores, including meters, cables, electrical accessories, lamps, carbon brushes, &c. (February 20th.)

March 22nd. Electricity Department. Coal-handling plant. (February 20th.)

Belgium.—March 27th. Municipal authorities of Liége. 5,000-kw. turbo-alternator for the central electricity generating station. Tenders to the Bureau des Adjudications des Services Industriels, 3, Rue Saint Etienne, Liége, whence particulars may be obtained.

April 9th. Municipal authorities of Haccourt (Province of Liége). Concession for the electric lighting of the town.

Bristol.—March 22nd. Board of Guardians. Electric lighting installation at Eastville Institution. (See this issue.)

Edinburgh.—March 29th. Electricity Supply Department. Condensing plant for Portobello station. Specification No. 23. (February 27th.)

Gellygaer. — March 21st. Urban District Council. Transformer plant, h.t. and l.t. switchgear, 11,000 v. and 500 v. overhead line material. (February 27th.)

Halifax. — March 12th. Tramways and Electricity Committee. One 1,000-kw. turbo-alternator, with condenser. (February 27th.)

Lincoln.—April 8th. Electricity Department. Pipework, and motor-generator and switchgear for St. Swithin's power station. (See this issue.)

London.—Great Central Railway. March 17th. Stores for 12 months, including electrical line construction, electrical apparatus, wires, cables, lamps, &c. Specifications from Mr. W. Williams, Stores Superintendent, G.C.R., Gorton, Manchester.

H.M. Office of Works. March 12th. Electrical accessories for 12 months. (February 27th.)

Macclesfield.—March 15th. County Asylum. Electrical goods for six months. Mr. W. G. F. Tingay, Clerk.

Margate.—March 15th. Town Council. Electric light installation, Municipal Buildings. Borough Surveyor, 13, Grosvenor Place.

Merthyr Tydfil. — March 9th. Board of Guardians. Electrical fittings for six months. The Workhouse Master.

Mountain Ash.—March 20th. Urban District Council Electricity Department. Transformer plant, h. and l.t. switchgear, three-core and four-core armoured cables and overhead line equipment. (See this issue.)

New Zealand.—Dunedin.—April 26th. City Council. (*a*) electric car bodies; (*b*) car trucks; and (*c*) car equipment. Documents may be consulted by British firms interested, at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, S.W. 1 (Room 49).

April 31st. Auckland Harbour Board. Electric cranes. Mr. R. B. Burnett, Secretary, Quay Street, Auckland.

Plymouth. — March 18th. Electricity Committee. Turbo-alternator, converter and booster. (February 27th.)

South Africa.—April 24th. Oudtshoorn Municipality. Time for receipt of tenders extended from March 24th to April 24th.

Swadlincote.—March 11th. Swadlincote and Ashby Joint Water Committee. Electric motors and turbine pumps. Mr. A. J. Mason, Engineers, Council Offices, Swadlincote.

Wakefield.—March 8th. Electric lighting installation at the Lofthouse Wesleyan Chapel. E. Howroyd, Secretary, Lofthouse.

CLOSED.

Australia.—P.M.G.'s Department, N.S.W.:—

Two 100 straight line units and associated apparatus for Chatswood telephone exchange, £1,850: two ditto for Mosman exchange.—Automatic Telephones (Aust.), Ltd.

Victorian Railways Department:—

Two electrically-operated "Q R" truck traversers, £2,408.—Johnson and Sons, Pty., Ltd.

Brunswick (Victoria) City Council:—

1,237 yd. and 1,295 yd. of three-core, 19/18, s.w.o., h.t., lead-covered, underground cable, £2,280.—W. T. Henley's Telegraph Works Co., Ltd. —*Tenders.*

Bavaria.—It is stated that the A.E.G. has been given the contract for the Munich-Landshut section in connection with the projected Bavarian State electricity works, and the Bergmann Co. that for the Sanding-Edelhausen section.

Government Contracts.—The following Government contracts were placed during January, 1920:—

Admiralty (Contract and Purchase Department).

Conduit tubing and fittings.—Barton & Sons, Ltd.; Brotherton Ediswan Tubes & Conduits, Ltd.
Conversion of steam crane.—Ransomes & Napier, Ltd.
Copper wires.—British Insulated & Helsby Cables, Ltd.; London Electric Wire Co. & Smiths, Ltd.
Electric capstans.—Douglas & Grant, Ltd.
Electric hoists.—Cowans & Sheldon, Ltd.
Insulating materials.—Abbott, Anderson & Abbott, Ltd.; H. Clarke & Co.; Micanite & Insulators Co., Ltd.; Mica Manufacturing Co., Ltd.; Siemens Bros. & Co., Ltd.; R. Whiffen.
Switch boxes.—Palmer's Shipbuilding & Iron Co., Ltd.
Phosphor bronze screws and nuts.—Automatic Standard Screw Co., Ltd.

Ministry of Munitions.

Carburetter spare.—S. Woll & Co., Ltd.; Zenith Carburettor Co., Ltd.
Electric fittings.—C. A. Vandervell & Co., Ltd.
Electrical plant. General Electric Co., Ltd.
Train lighting spare.—Chloride Electrical Storage Co., Ltd.

War Office.

Electrical installation, Cambridge Cottages, Woolwich.—G. Weston.

India Office: Stores Department.

Baudot apparatus.—Elliott Bros.
Telephone apparatus.—Automatic Telegraph Manufacturing Co., Ltd.
Cells.—Fuller's United Electric Works.
Telephone exchanges.—Relay Automatic Telephone Co., Ltd.
Generating sets.—Laurence Scott & Co., Ltd.

Post Office.

Telegraph and telephone apparatus.—Automatic Telephone Manufacturing Co., Ltd.; Creed & Co., Ltd.; C. Lange; Peel Conner Telephone Works, Ltd.; Siemens Bros. & Co., Ltd.
Telephone and telegraph cable.—B.I. & Helsby Cables, Ltd.; Connollys (Blackley), Ltd.; W. T. Glover & Co., Ltd.; Hackbridge Cable Co. Ltd.; W. T. Henley's Telegraph Works Co., Ltd.; Siemens Bros. & Co., Ltd.; Union Cable Co., Ltd.; Western Electric Co., Ltd.
Channels and covers.—McDowall Stevens & Co., Ltd.; Falkirk Iron Co., Ltd.
Telephone cords.—London Electric Wire Co. & Smiths, Ltd.
Earthenware ducts.—Jas. Oakes & Co.
Insulators.—Bullers, Ltd.; Doulton & Co.; J. Macintyre & Co., Ltd.; Taylor Tunnicliff & Co., Ltd.
Electric lamps.—British Thomson-Houston Co., Ltd.
Solder.—E. Austin & Sons; B.I. & Helsby Cables, Ltd.
Spindles for insulators.—F. W. Cotterell, Ltd.; Guest, Keen & Nettlefolds, Ltd.
Cable gear, H.M. Telegraph Ship "Alert."—Telegraph Construction & Maintenance Co., Ltd.
Laying conduits.—Bagshot: Greig & Matthews. London-Manchester (Loughborough-Derby, Section IV): Kettle & Son. Govan: R. & C. Murray. London-Manchester (Old Stratford-Loughborough, Section VII): J. F. Hodge & Co. Kingston-Richmond: J. Mowlem & Co. London-Southampton (Section IV): J. A. Ewart, Ltd. Widnes: Hodge Bros. (contractors), Ltd. Bolton (West): W. Pollett & Co., Ltd. Streatham-Norbury: Greig & Matthews. Burgh Heath: Greig & Matthews. Langside: Greig & Matthews. London-Southampton (Section III): W. Dobson. Finsbury, Shoreditch and Holborn: D. R. Paterson, Ltd. Kensington, Paddington and St. Marylebone: O. C. Summers. N. Camberwell, &c.: O. C. Summers. Chelsea (South Parade): G. I. Anderson, Faversham: Greig & Matthews, Littlehampton: Foot & Milne, Ltd. Hammersmith (N.E. area): D. R. Paterson, Ltd. Willesden Junction (Victoria Road): G. I. Anderson, Hove: Laing & Co.
Manufacturing, supplying, drawing-in and jointing cable.—Derby-Leicester: Siemens & Co., Ltd.
Repairing batteries.—Grimsby Automatic Telephone Exchange: D. P. Battery Co. G.P.O. (West): Pritchett & Gold and Electrical Power Storage Co., Ltd.
Telephone Exchange equipment.—"Toll" (London): Western Electric Co., Ltd. Northampton: Western Electric Co., Ltd. Harrow: Siemens Bros. & Co., Ltd. Hove: Western Electric Co., Ltd. Cambridge: Western Electric Co., Ltd.

Crown Agents for the Colonies.

Electric cranes.—Ransomes & Napier, Ltd.
Electric light fittings for railway carriages.—J. Stone & Co., Ltd.
Insulators.—Bullers, Ltd.
Electrolytic meters.—Reason Manufacturing Co., Ltd.
Switchboards, &c.—British L.M. Ericsson Manufacturing Co., Ltd.
Telegraph line material.—Siemens Bros. & Co., Ltd.; Bullers, Ltd.
Telephone material.—British L.M. Ericsson Manufacturing Co., Ltd.
Copper wire.—F. Smith & Co.; Shropshire Iron Co., Ltd.

Glasgow.—Tramways Committee:—

D.C.C. wire.—London Electric Wire Co. & Smiths, Ltd.
Control system of telephones.—Western Electric Co., Ltd.
Core drying oven.—A. Smith & Co.
Stoneware ducts.—Doultons.
12 miles copper trolley wire.—T. Bolton & Sons, Ltd.

It was reported that the following firms had intimated increases on their contract prices, viz.:—Bolokow, Vaughan & Co.; Shanks and Co.; Johnstone & Boath; and P. & W. M'Lellan.

Electricity Committee.—Recommended:—

One set of 1,500-kw. mercury-vapour rectifiers, at £11,000.—Brown, Boveri and Co., Ltd.

London.—St. Pancras.—The Electricity Committee has received a communication from the Brush Electrical Engineering Co., Ltd., suggesting that the order for the second 3,000-kw. turbine set, for which space has been provided by the disposal of the Browett-Lindley engines at the King's Road station, should be placed at once, as there is a large demand for power-house plant at the present time, and the moulders' strike having made deliveries very difficult, some time must necessarily elapse before castings for new orders can be taken in hand—and then only in rotation. Their present price for this plant, as compared with that of the first set, is as follows, the contract conditions remaining the same:—

Description.	Prices May 10th, 1918.	Present Prices.
3,000-kw. set (duplicate of plant already ordered)	£18,400	£23,650
Entry and connecting pipes	300	400
Wet-air filter	400	450

The Committee recommends the acceptance of the tender of the Brush Electrical Co., Ltd., at £24,450, for a second 3,000-kw. set, and that the order be placed forthwith.

Shoreditch.—Electricity Committee. Supply of cable:—

2½ miles ·25 sq. in. three-core E.H.T. 11,000-volt plain lead-covered cable, £5,017; 1 mile ditto ·15 sq. in., £1,910; 570 yds. ·113 sq. in. armoured ditto, £554; 1 mile 19/·05 sq. in. armoured three-core L.T. 600 v. cable, £572; 2 miles 7/·064 ditto, £802; 1,000 yds. 1 sq. in. plain lead-covered single-core 660 v. cable, £1,250; 1½ miles ·75 sq. in. ditto, £2,612; 500 yds. ·5 sq. in. ditto, £321; 300 yds. ·25 ditto, £106; ½ mile 19/·083 sq. in. ditto, £152; ½ mile 19/·064 ditto, £112; 1 mile 19/·052 ditto, £106; 2 miles 7/·064, £226.—Union Cable Co.

The tender is based on the price of electrolytic wire bars at £130 per ton, and English lead at £53 per ton. Seven firms tendered; the above was the lowest.

Rhondda.—Urban District Council. Messrs. Clough, Smith & Co., Ltd., Westminster, have been awarded the contract for the erection of overhead mains.

Salford.—Tramways Committee. Accepted:—

Armature and field coils.—Manchester Armature Repair Co., Ltd., and Metropolitan-Vickers Electrical Co., Ltd.
Cable connectors.—L. Andrews & Co.
Insulating varnish.—Griffiths Bros. & Co. (London), Ltd.
Insulating tapes.—R. W. Blackwell & Co., Ltd.
Steel tires.—Hadfields, Ltd.
Trolley-wheel bushes.—Fleming, Birkby & Goodall, Ltd.
Cast-iron and steel-backed brake blocks.—National Rail & Tramway Appliance Co., Ltd.
Gears and pinions.—British Hele-Shaw Patent Clutch Co., Ltd.
Car axles.—J. Baker & Co. (Rotherham), Ltd.
Two armatures for D.K. 110 motors, £180.—English Electric Co., Ltd.
E.H.T. switchgear, £1,154; additional E.H.T. switchgear for Trafford and Blackfriars sub-station, £552. Metropolitan-Vickers E ectrical Co., Ltd.
Two new water-tube boilers, superheaters, economisers, mechanical-draught plant, mechani al stokers and steel flues, at Frederick Road station, £ 8,459.—Babcock & Wilcox, Ltd.

Switzerland.—Quoting from the *Journal de Genève* the *Economic Review* states that the Swiss Federal Railway Council has ratified the agreements concluded in December, 1919, with Brown, Boveri et Cie., the Oerlikon Engineering Works and the Winterthur Locomotive Works, for the delivery of seven electric locomotives, and has authorised the necessary credit of Fr.5,515,000. The deliveries must be made by the end of January, 1921. The agreements concluded with the Société Industrielle Suisse de Neuhausen and the Schilleren Wagon Factory, for the delivery of 200 covered and 100 open wagons, were also approved.

FORTHCOMING EVENTS.

Royal Institution of Great Britain.—Saturday, March 6th. At Albemarle Street, W. At 3 p.m. Lecture on "Positive Rays" by Sir J. J. Thomson, President R.S.
Monday, March 8th. At Albemarle Street, W. At 5 p.m. Lecture on "Modern Development of the Miner's Safety Lamp," by Sir John Cadman.
Friday, March 12th. At Albemarle Street, W. At 9 p.m. Lecture on "The Thermionic Valve in Wireless Telegraphy and Telephony," by Prof. J. A. Fleming, F.R.S.

Anglo-French Society.—Saturday, March 6th. At the Æolian Hall, New Bond Street, W. At 5.45 p.m. Lecture in French on "The Channel Tunnel," by Baron E. B. d'Erlanger.

Association of Engineering and Shipbuilding Draughtsmen.—Tuesday, March 9th. At the Liverpool University. At 7.30 p.m. Lecture on "Elementary Calculus," by Mr. S. Clowes.
Thursday, March 11th. At the Grammar School, Chesterfield. At 7.30 p.m. Lecture on "The Principles and Design of Centrifugal Fans," by Mr. F. Clements.

Association of Engineers-in-Charge.—Wednesday, March 10th. At St. Bride's Institute, Ludgate Circus, E.C. At 7.30 p.m. Paper on "The Solidification and Crystallisation of Metals," by Mr. L. Aitchison.

Edinburgh Electrical Society.—Wednesday, March 10th. At the Philosophical Institution. At 7.30 p.m. "Questions and Answers" Night.

Royal Society of Arts.—Wednesday, March 10th. At John Street, Adelphi, W.C. At 4.30 p.m. Paper on "Gas in Relation to Industrial Production and National Economy," by Mr. H. M. Thornton.

Institute of Metals.—Thursday, March 11th. At 4 p.m. At the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W. Annual General Meeting. Friday, March 12th. At 10.30 a.m. Annual dinner.

Institution of Electrical Engineers.—Thursday, March 11th. At the Institution of Civil Engineers, Great George Street, S.W. At 6 p.m. Papers on "Notes on Operating a By-product Producer Gas Plant for Power and Heating," by Mr. W. H. Patchell, and "Production of Power from Blast Furnace Gas," by Mr. S. H. Fowles.
(North-Midland Centre).—Tuesday, March 9th. At the Hotel Metropole, Leeds. At 7 p.m. Ordinary meeting.
(Scottish Centre).—Tuesday, March 9th. At Prince's Station Hotel, Edinburgh. At 7 p.m. Paper on "The Protection of Alternating Current Distribution Systems Without the Use of Special Conductors," by Major K. Edgcumbe, R.E.

Junior Institution of Engineers.—Friday, March 12th. At 39, Victoria Street, S.W. At 7.30 p.m. Lecturette, "Chain Helice Pumps," by Mr. F. A. Simpson.

International Motor Boat and Marine and Stationary Engine Exhibition at Olympia.—March 12th to 20th. 11 a.m. to 9 p.m.

NOTES.

Batti-Wallahs' Society.—At the luncheon on March 15th, Mr. F. Pooley (secretary and treasurer) will be the chief speaker.

The Electricity Commissioners.—It is reported that one or more of the Electricity Commissioners in the near future will undertake a tour of investigation in the provinces with a view to examining on the spot various propositions which have been prepared under the provisions of the Electricity Supply Act, and drawing up a report thereon.

Coal Conservation.—On Friday next, March 12th, the annual public meeting of the University College, London, Engineering Society, will be held in the Botanical Theatre, at the College, at 5.30 p.m. An address will be given by Sir Dugald Clerk, F.R.S., on "Coal Conservation," to which visitors are welcomed.

L.C.C. Tramway Staff Reorganisation.—In connection with the reorganisation of the L.C.C. Tramways Department, the Highways Committee recommends the following classification of the technical and clerical staff of the department under the direction of the Committee, the alterations in the fixed staff of the tramways department to take effect as from January 1st, 1920, the salaries being based on pre-war conditions:—

Traffic Branch.—Traffic manager, £1,200 by £50 a year to £1,500; development superintendent, £500 by four annual increments of £25 and four of £50 to £800; operation superintendent, £600 by £50 a year to £800; divisional superintendent (north), £300 by £25 a year to £400; divisional superintendent (south), £300 by £25 a year to £400; publicity assistant, £300 by £25 a year to £400; traffic statistics assistant, £300 by £25 a year to £400; time tables assistant, £250 by £12 10s. a year to £300; motor school superintendent, £255 by £15 a year to £300.

Electrical Branch.—Electrical engineer, £1,200 by £50 a year to £1,500; assistant electrical engineer, £600 by four annual increments of £25 and two of £50 to £800; power station engineer, £500 by four annual increments of £25 and two of £50 to £700; distribution engineer, £500 by £25 a year to £700; assistant distribution engineer (north), £350 by £12 10s. a year to £400; assistant distribution engineer (south), £350 by £12 10s. a year to £400; assistant power station engineer, £400 by £20 a year to £500; repairs superintendent, £300 by £20 a year to £400; boiler house superintendent, £300 by £20 a year to £400; sub-station superintendent (north), £250 by £12 10s. a year to £300; sub-station superintendent (south), £250 by £12 10s. a year to £300; mains superintendents, £250 by £12 10s. a year to £300; boiler house charge engineer, £250 by £10 a year to £300; charge shift engineers, £250 by £10 a year to £300; sub-station repairs inspector, £200 by £12 10s. a year to £250; senior technical assistant, £400 by £25 a year to £500; technical assistant (grade 1), £300 by £20 to £400; technical assistant (grade 2), £250 by £12 10s. to £300; technical assistant (grade 3), £200 by £12 10s. to £250.

Rolling Stock Branch.—Rolling stock engineer, £1,000 by £50 a year to £1,200; rolling stock superintendent, £400 by £25 a year to £600; superintendent (central car repair depôt), £400 by £25 a year to £600; cartage superintendent, £255 by £15 a year to £300; technical assistant (grade 2), £250 by £12 10s. a year to £300; rolling stock inspector, £230 by £10 a year to £280.

Permanent Way Branch.—Permanent way engineer, £800 by £50 a year to £1,000; assistant permanent way engineer, £300 by £25 a year to £400; principal technical assistant (from August 1st, 1921), £500 by £25 a year to £600; senior technical assistant (until August 1st, 1921), £400 by £25 a year to £500; building superintendent, £400 by £25 a year to £500; technical assistant (grade 2), £250 by £12 10s. to £300; technical assistant (grade 3), £200 by £12 10s. to £250.

General Branch.—Chief clerk, £600 by £50 a year to £800; tramways accountant, £600 (personal to the present holder of the position); stores superintendent, £400 by £25 a year to £600; assistant stores superintendent, £260 by £15 a year to £350; claims superintendent, £300 by £25 a year to £400; printing shop superintendent, £250 by £10 a year to £300; superintendent of women checkers, £200 by £12 10s. a year to £250.

Secretariat.—Principal technical assistant, £500 by £25 to £600; technical assistant (grade 1), £300 by £20 to £400.

The proposed scales of salaries are subject to the appropriate temporary percentage additions, plus war bonus, making the total annual remuneration at the present time (February, 1920) on these scales as follows:—

Traffic manager and electrical engineer, £1,400 to £1,780; rolling stock engineer, £1,180 to £1,440; permanent-way engineer, £960 to £1,180; assistant electrical engineer, £610 to £1,060; operation superintendent and chief clerk, £752 10s. to £950; development superintendent, £850 to £900; power-station engineer and distribution engineer, £840 to £880; tramways accountant, £752 10s.; principal technical assistants, £680 to £752 10s.; rolling stock superintendent, superintendent (central car repair depôt), and stores superintendent, £565 to £752 10s.; assistant power-station engineer and senior technical assistant (electrical branch), £570 to £690; building superintendent and senior technical assistants (other than electrical branch), £565 to £650; assistant distribution engineers (north and south), £510 to £570; repairs superintendent and boiler-house superintendent technical assistants (grade 1: electrical branch), £420 to £570; divisional superintendents (north and south), publicity assistant, traffic statistics assistant, technical assistants (grade 1: other than electrical branch), assistant permanent-way engineers, claims superintendent, £420 to £500; motor-school superintendent and carriage superintendent, £369 5s. to £420; assistant stores superintendent, £376 to £420; sub-station superintendents (north and south), mains superintendent, boiler-house charge engineer, charge shift engineers and technical assistants (grade 2: electrical branch), £360 to £420; time tables assistant, technical assistants (grade 2: other than electrical branch), and printing-shop superintendent, £301 10s. to £420; rolling-stock inspectors, £307 to £405; sub-station repairs inspector and technical assistants (grade 3: electrical branch), £300 to £360; technical assistants (grade 3: other than electrical branch), £301 to £354 10s.; and superintendent of women checkers, £280 10s. to £341 10s.

Submersible Motors. — We have from time to time referred to the submersible electric motor pumps that rendered such goood service to the Navy and in marine salvage operations during the war period. Some interesting experiments were recently carried out in Cheshire with a view to demonstrating the possibilities of this apparatus for mine work. According to the *Colliery Guardian*, a manufacturing firm was considering the use of the water draining into an abandoned mine shaft. The shaft in question was awkwardly situated, and contained a quantity of *débris* of all kinds, rendering the use of ordinary pumps practically impossible. The firm approached the Admiralty, and was referred by the latter to Submersible Motors, Ltd., who, after inspecting the scene of operations, undertook to carry out the work. It was desired to lower the water to a depth of about 160 ft. from the ground level with a view of ascertaining what was the daily inflow. The plant used consisted of two 4-in. submersible motor-pumps, each of which had a rated output of 370 G.P.M. at 80 ft. total head. The delivery side of one pump was coupled to the suction side of the second pump, thus forming the equivalent of a two-stage centrifugal pump capable of a lift of 160 ft. For supplying the electric power a portable generating plant was used consisting of a three-phase alternator and exciter coupled to a paraffin engine. The whole set, together with the necessary switchgear, mounted on a wheeled truck, can be readily moved about and is of weather-proof construction. A suitable headgear was erected and the motor-pumps, connected by flexible electric cables to the generating plant, were lowered into the shaft, the bottom pump being 160 ft. from the surface, and the second one about 80 ft., several obstructions being encountered on the way. Armoured flexible rubber hose was used for the pipe line. The daily flow of water into this pit being found insufficient, it was decided to make a further trial at some other pits nearer the company's factory. Here were three shafts linked together by workings, the water level standing 11 ft. from the surface, and it was desired to lower the water to about 300 ft. In this case the supply of electric power was obtained from the company's works. Four 6-in. submersible motor-pumps were used, each having a normal duty of 740 G.P.M. at 75 ft. head. They were coupled in pairs, the first pair being lowered to a depth of 310 ft. and the second pair to 150 ft. No flexible 6-in. hose being available for the pipe line, steel tube was used, and considerable difficulty was experienced in lowering this, owing to the numerous obstructions in the shaft. After pumping continuously for five days the water level was lowered to 160 ft., and after a further seven days to 275 ft. Delivery was then throttled to maintain a constant level at this depth, and readings taken of the inflow. Altogether the plant was running for 37 days, one pair of pumps running for 24 days on end, and on 19 of these days for the whole of the 24 hours. The total quantity of water pumped was 33,623,604 gals. Great difficulty was experienced in raising the pumps and pipe line, which constantly caught in brickwork and stagings, necessitating several descents in the "bo'sun's chair" down the pit to free it, one as low as 240 ft., all other methods having failed. This was a perilous undertaking, owing to the rotten state of the brickwork lining, and none of the local miners being willing to go down, it was, therefore, left to the Submersible Co.'s engineer and his assistant to do this. The whole operation was entirely successful, and credit is due to the Submersible Co.'s engineer, Mr. Mackenzie, and his assistant, Mr. Chalk, for the successful manner in which they overcame the numerous difficulties encountered on this novel undertaking, which demonstrated clearly the use which can be made of these submersible motor-pumps in places where the use of ordinary pumping plant would be impracticable or costly.

The Electric Smelting of Iron Ores.—In *Chemical and Metallurgical Engineering*, Vol. 20, No. 12, an abstract was given of an exhaustive report by Dr. Stansfield (Bulletin No. 2, 1919, British Columbia Department of Mines) on the commercial possibilities of electric smelting of iron ores in British Columbia. The report says:—

"The possibility of the commercial operation of an electric smelting plant for the production of pig iron from iron ore depends on an adequate supply of electrical power at a moderate price. A large amount of power is needed, the amount varying somewhat with the richness of the ore, the grade of iron to be produced, and the kind of furnace employed. Under usual conditions the consumption of electrical power for each long ton of pig iron ranges from one-third to one-half of a H.P.-year. For foundry iron production from rather low-grade ores, and in a simple pit furnace, more than two long tons of iron per annum cannot safely be reckoned upon. For a daily output of 50 tons of pig iron some 8,000 or 9,000 E.H.P. will be needed, and if provision is made for the production of ferro-alloys and steel in electric furnaces, 10,000 to 15,000 H.P. will be required."

At the time of Dr. Stansfield's visit to Vancouver the probable cost of power worked out at about $15 per E.H.P.-year, and at this price electric smelting seemed commercially feasible. When his report was nearing completion he was given to understand that the charges for electric power would be nearly twice the figure assumed in his calculations, and under this changed condition his conclusion is that the electric smelting of iron ores by existing methods is scarcely possible, and the only remaining opening, unless cheaper power can be obtained, is by developing a new process.

It appears, however, that there is ample undeveloped power going to waste—a fact which is applicable to this country as well—and Dr. Stansfield was furnished with estimates showing that 340,000 H.P. at three accessible points could be developed for smelting purposes at about $10 per H.P.-year. Such costs would be lower than for ordinary users since the load factor would easily approach 90 per cent.

In the Swedish furnaces at the time of Dr. Stansfield's visit in 1914 the electrodes used were 24 in. in diameter and 4 or 5 ft. in length. They had threaded ends for the addition of fresh lengths, were of amorphous carbon, and cost about 4 cents per lb. When making white pig iron from high-class ores the electrode consumption was about 10 to 15 lb. per ton of pig iron, thus costing about 50 cents per ton of product. In melting lower grade ores for foundry iron, Dr. Stansfield considers that the consumption might be from 15 to 20 lb., and that at the present prices in Columbia this would mean about $1.50 per ton of pig. A furnace of 3,000 KW. uses six of these 24-in. electrodes.

The cost of making pig iron in the Swedish furnace as given by Electro-Metals for a large plant of an annual capacity of 60,000 tons of white iron works out at $11.50 per ton, showing what can be done under exceptionally favourable circumstances. Dr. Stansfield's estimate for a British Columbian plant in 1918, with an output of 27,000 tons of grey iron per annum, is from $29.75 to a minimum of $23.90 per ton. In pit furnaces (10,000-KW. plant) one long ton of foundry iron would cost about $36.81.

The cost per long ton of blast-furnace pig iron works out at $25.95 per ton, showing that "there does not appear to be any reason why electric-furnace iron should cost more than blast-furnace iron under the conditions we find on the coast, and providing that power can be had at $15 or less."

The Panama Canal.—The Panama Canal report for the year ending June 30th, 1919, gives a *resumé* of canal operations for twelve months, during which the use of the canal was not interfered with by slides or other serious accidents. The period under review cannot be regarded as indicative of the canal's ultimate value as a trade route, on account of the period being an abnormal one. According to *Engineering*, the total amount of water passing off the useful catchment area per month averaged 15,410 million cu. ft., of which amount 35.24 per cent. was put to use, but only 9.232 per cent. was used for lockages. Of the water lost, 8,094 million cu. ft. went over the Gatun spillway, and 12 per cent., or 1,907 million cu. ft. were lost by evaporation. Leakage at the locks and spillway amounted to 44 million cu. ft. Of the water used 3,611 million cu. ft. was the average for the amount taken by the hydro-electric plant at Gatun. The lockages absorbed 1,423 million cu. ft. The electric plant used 66.5 per cent. of the water usefully employed, or about 20 per cent. of the yield of the watershed.

The electric towing system at the locks met with two accidents during the year; both due to a fault in design and since remedied. Both accidents happened to the same locomotive. In each case getting out of control it ran down one of the inclines. These locomotives are not under control when the clutch lever is in the neutral position. As an expedient a bell has now been fitted which continues ringing so long as both clutch levers are out of either the 2-M.P.H. or 5-M.P.H. notches, at both ends of the machine. A new brake is also being fitted which will operate regardless of the clutch levers. The actual lockage operations suffered a delay of about five hours on one occasion owing to the accidental flooding of the transformer rooms in the lock walls at Miraflores, from which it would appear that the interlocking of the controls is not so complete as it should be. As already described in our pages, the hydroelectric plant has been extended. The steam-generating plant at Miraflores is, therefore, an emergency standby. Steam is kept up in the boilers by small oil fires, and the plant is started automatically on failure of the Gatun supply. Failures in the 44,000-volt transmission line across the isthmus have been greatly reduced by the introduction of additional units to the insulators. These failures numbered 17 in 1917, 29 in 1918, while from July, 1918, to February, 1919, no less than 32 occurred. After the new insulation was effected in February, down till the end of June of last year, no failures had been reported.

Summer Time.—An Order in Council was made on Tuesday, directing that Summer Time shall commence on March 28th, and last until September 27th. According to the French Ministry of Public Works, in a report quoted by the daily Press, Summer Time in France has during the last four years saved an hour's lighting by 39,000,000 people for seven months in the year. It saves on lighting £2,400,000 a year. The total saving on electric lighting is reckoned at 15 per cent., and on gas lighting at 5 per cent. As, this year, Summer Time is beginning a fortnight earlier, and will end 19 days later, it is estimated that a further saving of £374,000 will be effected.

Engineering Golfing Society.—The 11th annual general meeting of the Engineering Golfing Society was held at the Institution of Civil Engineers, Great George Street, Westminster, on Thursday, February 26th, when, in the absence of the President, Sir A. B. W. Kennedy, and the retiring Captain, Mr. Midgley Taylor, the chair was taken by Mr. F. J. Walker, one of the vice-presidents. The following were elected office-bearers for the ensuing year :—

President	Sir Alexander B. W. Kennedy.
Vice-Presidents ..	D. A. Stevenson, E. L. Mansergh, F. J. Walker, S. Price-Williams, G. Midgley Taylor.
Captain	W. H. Shortt.
Honorary Secretary ..	W. L. Mansergh, 5, Victoria Street, S.W.
Honorary Treasurer	S. R. Lowcock.

Although the membership of the society is steadily increasing, the opinion was expressed that there must be many members of the Engineering Institutions who are interested in golf, and who are eligible to join the society.

Stalybridge Dispute. — According to the *Manchester Guardian*, attempts were made on February 27th, at the meeting of the Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board, to reopen the question of the dispute with the shift engineers, who ceased work in December. The Board declined to move in the matter, and rejected three proposals—to appoint a sub-committee to go into the matter and report, to refer it to the National Joint Industrial Council for the Electricity Supply Industries, and to allow two delegates to appear before the next meeting of the General Purposes Committee. It was revealed in further discussion that the Ministry of Labour had written to the Board in regard to the dispute, and had expressed the opinion that further steps should be taken to obtain an amicable adjustment of the difficulty, and it suggested a meeting between the Board and representatatives of the men's association. The Generating Committee replied that a new permanent staff had been appointed, that a full and increasing load was being carried at the generating station, and that the Committee felt compelled to decline the invitation of the Ministry to enter into further discussion of the matter.

Society of Technical Engineers.—A general meeting of the Bristol and West of England Branch was held at Bristol on February 27th, but there was only a sparse attendance. A paper, entitled "Organised Effort : Its Relation to Present Needs," was was read by Mr. A. Lennox Stanton, A.M.I.E.E., who outlined the origin of protective associations, and what had been accomplished by organised effort during the war, and pointed out that the most unorganised section of the community was the majority of professional workers, whose position in the economic life of the nation and the world's work was of the highest importance. The paper was illustrated by lantern slides, and a short discussion followed.

Appointments Vacant.—Mains engineer (£330) for the City of Carlisle electricity department; plumber-jointer (98s. 1d.) for the Hackney Borough Council electricity department; meter repairer, also meter fixer, for the Borough of Hornsey electricity works; fitter for the Nuneaton Corporation electricity works; shift engineer (£234), mains assistant (£208), control engineer (£234) for the Kilmarnock Corporation Electricity Works; electrical engineer and manager (£750) for the City of Peterborough Electricity Works. See our advertisement pages to-day.

Isaacs v. Hobhouse.—An echo of this libel case of 1918 has reached us in the shape of a circular signed by Mr. Godfrey C. Isaacs, and containing extracts from correspondence with Germany which was unobtainable during the trial of the action. The letters relate, mainly, to Sir Henry Norman's relations with Baron von Lepel before the war.

The Fullerphone.—At the sitting of the Royal Commission on Awards and Inventions, on March 1st, the claims heard were those of Major A. C. Fuller, in respect of his telephonic apparatus.

The device which, it is admitted, prevented eavesdropping by the enemy so far as telegraphic messages were concerned, and the manner in which silence is obtained, were explained by counsel. The President, Mr. Justice Sargant, remarked that the matter was very technical, and a good knowledge of electricity was necessary fully to understand it. Major A. C. Fuller said that his invention was made about November, 1915, and he took it to General Boyce. The only royalties he had obtained were about £1,800 from the French Government for the four other instruments they had made towards the close of the war. For two years he had endeavoured to obtain something from the American Government for its use of the system, but without success. General Sir John Fowler, Signals Officer-in-Chief to the British Army, said in reply to Mr Trevor Watson, for the Treasury, that secrecy applied only to messages telegraphed over the line, and not to those telephoned. Judgment was reserved.

INSTITUTION NOTES.

Institution of Electrical Engineers.—The annual dinner of the North Midland Centre was held at the Queen's Hotel, Leeds, on Friday last. Mr. W. M. Selvey, chairman of the Centre, presided, and amongst those present were the president (Mr. Roger T. Smith) and secretary (Mr. P. F. Rowell), Mr. J. A. Robertson, Lieut.-Col. W. A. Vignoles, D.S.O., Mr. Hugh Lupton, Lieut.-Col. E. Kitson Clark, Messrs. Ll. B. Atkinson and W. B. Woodhouse, vice-presidents, and Mr. J. D. Bailie, hon. secretary of the Centre.

After the loyal toast had been duly honoured, Mr. J. A. Robertson proposed "His Majesty's Forces," drawing a contrast between the attitude of the nation towards the Army in 1914 and that of the present day, when the Army, in its various branches, includes the whole nation; he eulogised the work of the Navy and the mercantile marine, the most efficient Air Force in the world, and the women who played a great part in the war, and urged that in future the burden of military service must be equally shared by all—we must be prepared for war. Before the toast was drunk, the audience stood in silent tribute to the fallen. In responding, Lieut.-Col. Vignoles touched upon the historic exploits of the Navy and Army and the Auxiliary Forces, and said we must in the future take the Army seriously, and provide an adequate force to guard against a recurrence of the conflict.

Mr. Lupton proposed "The Institution of Electrical Engineers," which in 50 years had grown from 110 to 8,000 members, and suggested that as the Electricity Act did not provide the necessary funds for development, an Act should be passed empowering municipalities to take shares in companies, with corresponding representation on the directorate, as a solution of the difficulty.

The President, responding, received a "Yorkshire welcome" he said he served his apprenticeship in Leeds, and told amusing anecdotes of work and sport in those days, remarking that the knowledge he then gained of workers' ways had been of the utmost value to him. The Institution now had seven Centres and four Sub-Centres, and one part of its activities was thoroughly decentralised. The question had been raised why should there not be a "London Centre"? He pointed out that the membership in and around London equalled that of all the Centres and Sub-Centres combined. Every Centre cost money, and when the Institution was back in its old home, the great problem would be that of finance. He was heartily in agreement with this democratic development, in which the Institution was showing the way to kindred Societies, but it would be successful only if the members would provide the funds.

Mr. Selvey, in briefly proposing "Our Guests," remarked that electrical engineers had been so absorbed in giving the public cheap power, that they forgot to give themselves adequate salaries; but that mistake was in process of rectification, and the prospects before the electrical industry were rosy. Mr. Alderman R. A. Smithson responded.

Lieut.-Col. E. Kitson Clark proposed "The Electrical Industries," humorously deprecating the attempts of electrical engineers to supersede the steam locomotive.

Mr. Ll. B. Atkinson replied, with many interesting reminiscences of his apprenticeship at Airedale Foundry and old times in Leeds. He said that members of the electrical industry had been very ill-rewarded for their efforts; the true reason was the competition with extraordinarily cheap coal, the greatest enemy of electricity. Other countries had had to economise coal, and for that reason they developed electricity. But coal would never be cheap again, and now electricity was king. Manufacturers were snowed under with orders, and the great problem was to get the work done. Industrial peace was the prime necessity.

Mr. W. B. Woodhouse, proposing "Kindred Societies," said the keynotes of progress were specialisation, organisation, and co-operation. Electrical engineers were necessarily specialists, and must also depend in many ways on other specialists; it was the function of kindred Societies to look after the other kinds of specialists. Too much time might be spent on organisation, losing sight of the results that were to be produced; there were so many Societies that one had to know them by initials. The co-operation of other bodies had been extremely valuable to the I.E.E., which was hoping to collaborate with the Institution of Civil Engineers in connection with the registration of engineers.

Mr. W. T. Lancashire, M.Inst.C.E., City engineer, in responding, said that all would agree that those who had to take care of the public health should be properly qualified. Leeds was engaged in town-planning, to which the help of electrical engineers was indispensable, to provide rapid transport and power for smokeless factories near the houses.

The chairman's health, proposed by Mr. Woodhouse, was toasted with musical honours. During the evening a programme of music was performed, and Mr. Harrison Hill ably entertained the guests with song and story.

At the meeting of the Western Centre at Bristol on Monday last, it was announced that a summer meeting of the Institution had been arranged in the Western Centre commencing on Tuesday, July 13th, and terminating on Friday, July 16th. A tentative programme had been drawn up, and would be submitted to headquarters for approval. The time-table for the summer meeting would be as follows :—

Tuesday, July 13th.—Cardiff—opening meeting and civic reception.
Wednesday, July 14th.—Newport in morning, returning *via* Bargoed to Cardiff.
Thursday, July 15th.—Visit to Bristol.
Friday, July 16th.—Swansea—concluding meeting.

Prof. David Robertson delivered a lecture on "Electric Impulse Clocks," illustrated by a lantern demonstration and working models.

At the Informal Meeting, on Monday last, Mr. R. E. Dickinson read a paper on "The Future of Labour in the Engineering Industry." He described shortly the causes of the rise of Trade Unionism, and the present-day need for Unions in order to prevent victimisation, and finished by mentioning the Guild System and the Manchester Builders' Guilds' offer to supply houses cheaply. Mr. Rankin was welcomed back after his illness, and opened the discussion. Many others spoke. The general opinion was that labour should be given responsibility, and educated to understand the ramifications of trade and industry, and that labour unrest was a reaction from evil actions of bad employers in the past (cutting piece rates, &c.). Strikes were taboo; but E.P.E.A. men realised the difficulties of obtaining justice when many authorities agreed to go to arbitration *re* salary claims, and then only a proportion of them paid the award.

The chairman's final words suggested that men would respond to an appeal to serve the nation now in peace time as they had responded to the country's call for service in war time.

Association of Mining Electrical Engineers.—The Yorks. Branch held a meeting at Wakefield, on February 21st, when a paper by Mr. Robert Rae, on "Practical Machine Coal-Mining," was read. The uses and disadvantages of coal-cutting machines were discussed at length, and various opinions were expressed as to the efficiency of the machines.

Edinburgh Electrical Society.—Lieut.-Colonel Ogilvie, O.B.E., T.D., delivered a lecture to the Society on Wednesday, Feb. 26th, the title being "Electric Projectors and Some of their Uses." The lecturer indicated the principles which govern the disposition of searchlights for trench, estuary, ship, and aerial use. The development from the simple hand-fed inclined-arc type through varied forms and stages to the modern 60-in. projector, with its high-intensity carbons, was interestingly illustrated, and the various methods of deflecting and dispersing, distorting and dividing the beams were described and discussed. The war functions of projectors for locating, illuminating, and altitude-finding were indicated, and examples quoted of their use for whale fishing and navigation.

On Wednesday, March 3rd, Mr. J. Plucknett, A.M.I.E.E., read a paper on "Petrol Gas Plant for Electrical Engineers." The paper was accompanied by practical demonstrations of gas generators and other apparatus.

The next meeting, on March 10th, will be devoted to a general discussion on minor questions of electrical practice and to "Questions and Answers." The membership of the Society continues to make gratifying progress.

Institution of Civil Engineers of Ireland.—In a paper read on February 2nd, Mr. G. Marshall Harriss pointed out that the staple industry in Ireland was agriculture, and that the increased output per worker that was necessary could only be obtained with the aid of cheap power. Irish coal mines were not sufficiently developed; the abundant supply of peat possessed great possibilities, and the water power was only limited by the amount of capital required to develop it. Numerous small water powers were in full operation 80 years ago, but the vast majority were now disused; difficulties arose from the seasonal variations in the flow, and the necessity in those days of using the power on the spot. Cheap coal put the water powers out of action. Now the water turbine and electrical transmission had changed the situation, and as so little labour was required for operation, there was no fear of strikes interrupting the supply. The variation of flow mattered less if the hydro-electric station was linked up with steam stations. On the River Dee at Chester, Mr. S. E. Britton had secured an output of 7,300,000 units sold (during five years) from water power of 600 H.P., and 6,900,000 from steam plant, the capital cost of the former being £18,473, and of the latter £55,992. The total works costs per unit, including capital charges, were for steam 1·462d., and for water power 0·172d. Consequently, Mr. Britton proposed to develop the power of the Dee at 16 places linked together, and capable of producing 60 million units a year, of which 50 millions would be used for agriculture. The total cost of plant and mains was estimated at £600,200, and at 1·5d. per unit, the revenue would be £298,922, the expenses £93,542, and the surplus £205,468. State aid was essential, but State control undesirable, leading inevitably to inefficiency and waste. It was proposed to utilise the power of the Liffey at the Salmon Leap, where with a 35-ft. head, 1,500 KW. could be developed for 20 weeks in the year, and less at other times. The total cost was estimated at £38,500 (£26 per KW.), and a net output of 8,000,000 units per annum could be counted upon, at a total works cost of 0·138d. per unit generated. The Dublin and Lucan Electric Railway would take 250,000 units, and the remainder would be fed into the Dublin systems 7 miles away, at a total cost of 0·3225d. per unit. The cost of coal alone was at present over 1d. per unit in Dublin. Two other falls, of 26 and 104 ft. head respectively, could easily be developed, and would yield over 30 million units a year. The proposal was receiving practical attention.

Leeds Association of Engineers.—A lecture was delivered at Huddersfield on February 26th by Mr. W. H. Child, on "The Transmission of Power by means of Machine-cut Gearing."

Wireless Society of London.—At the last meeting on February 27th at the Royal Society of Arts, the President, Mr. A. A. Campbell Swinton, F.R.S., delivered his address, the subject being "Some Wireless Wonders."

Birmingham and District Electric Club.—At a meeting on February 21st, a paper was read by Major R. V. C. Brook (member) on "Electric Vehicles." The paper was comprehensive and dealt with the early history, progress, limitations and advantages of the "Electric." The writer urged the importance to the electrical industry of an increased interest in this branch of the business; but insisted that it was necessary to realise that the "Electric" had certain limitations, and must not be indiscriminately recommended. In the present state of development of batteries, the "Electric" could not show advantages for long-distance work; but for short hauls, such as town and suburban deliveries, refuse collection, coal cartage, interworks duties, street cleaning, and a host of similar duties, the "Electric" could show considerable economy and efficiency over any other methods of transport. The author gave tabulated examples of running costs and reliability in comparison with other types, and proved conclusively that electric vehicles, in their own particular field, had a future in which neither horse, petrol nor steam could compete. Major Brook appealed to all electrical engineers, in the interests of the industry, to do all in their power to spread the gospel of the economical electric vehicle.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

After 21 years' service, Mr. D. G. Brooks severed his connection with Simplex Conduits, Ltd., in October last, when he was presented by the staff and workpeople at Garrison Lane, with a silver tea service, and by the branches with a silver coffee service. He has now joined forces with the Walsall Hardware Manufacturing Co., Ltd., and will take up the sales direction over a large part of England, Wales, and Scotland.

Mr. W. W. Lackie and Mr. A. Page were entertained to dinner on February 23rd in the Conservative Club, Glasgow, by past and present members of the Committee of the Scottish Local Centre of the Institution of Electrical Engineers, to mark their recent appointments as Electricity Commissioners. Mr. W. B. Hird, chairman of the Centre, presided, and proposed the toast of the evening. Prof. Maclean proposed Mr. Goslin's health, and Mr. Sam Mavor toasted Mr. Joseph Taylor, secretary of the Scottish Centre.

Mr. E. T. Goslin, M.I.E.E., electrical engineer to the Glasgow Corporation tramways, having been appointed general manager of the Clyde Valley Electric Power Co. in succession to Mr. A. Page, we have pleasure in reproducing his portrait. Mr. Goslin, after

E. T. Goslin.

acquiring experience with Messrs. Crompton & Co., Ltd., the Hove Electric Lighting Co., and the County of London Co., entered the Glasgow Tramways Department, of which he has been chief electrical engineer for 18 years. He has been a J.P. for three years, and during the war was Deputy Director of Labour under the Ministry of National Service.

Mr. W. G. Watson, managing director of W. G. Watson & Co., Ltd., of Sydney, is on his way to England and U.S.A. in connection with the company's business. He expects to be in London about May or June next, and communications may be addressed to him c/o The Editor of the Electrical Review, or c/o English, Scottish, and Australian Bank, Ltd., Head Office, London.

The Bedford Town Council has appointed Mr. Blaikie, M.I.M.E., as supervising engineer for the new electricity works, at a salary of £7 7s. per week.

Mr. P. Wardle, mains and sub-station superintendent in the Carlisle electricity department, has been appointed mains engineer at Walsall, in succession to Mr. J. D. Spark.

The employés of the Yorkshire (West Riding) Electric Tramways Co. have presented a gold watch to Mr. A. King, for 13 years traffic superintendent at Castleford, on his leaving to join the Electrical Contracting and Motor Co.

Reigate Town Council has increased the salary of the electrical engineer, Mr. W. S. Ross, by £60 a year.

Lieut.-Colonel H. C. Fraser, D.S.O., has been appointed Superintendent of Organisation for the Yorkshire Electric Power Co. Colonel Fraser, during his military service, was in turn Commanding Officer of the 4th Battalion of the Yorkshire Light Infantry and of the Yorkshire Dragoons.

Messrs. A. Murray Coombs and A. F. W. Richards, advisory and inspecting engineers, have removed from 25, Victoria Street, to Cross Keys House, 56, Moorgate Street, E.C. 2. Telephone: London Wall 9080.

Mr. Justus Eck having realised his interest in the Phonopore Construction Co., Ltd., has retired from the board, and resigned the secretaryship.

The salary of Mr. R. B. Leach, borough electrical engineer of Loughborough, has been increased to £550 per annum, as from January 1st. Mr. Leach also holds the appointment of Local Fuel Overseer under the Board of Trade Household Fuel and Lighting Order, for the Corporation of Loughborough.

Obituary.—Mr. G. E. Young.—The death has occurred at Southdene, Unstone, of Mr. G. E. Young, aged 57, who had for 16 years been chief electrical engineer to the Sheepbridge Coal and Iron Co., Ltd., of Chesterfield.

Will.—The late Lord Rayleigh left £172,245 unsettled net personalty.

NEW COMPANIES REGISTERED.

Campion Ball & Co., Ltd. (164,342).—Private company. Registered February 21st. Capital, £2,000 in £1 shares. To take over the business carried on at Regent Terrace, West Street, Sheffield, as "Campion Ball & Co.," and to carry on the business of electrical engineers, &c. The subscribers (each with one share) are: W. J. Campion, 36, Lydgate Lane, Sheffield, manufacturers' agent; T. E. Osborne, 12, Banner Cross Road, Ecclesall, Sheffield, cutlery handle manufacturer. The first directors are not named. Solicitor: W. E. Esam, 29, Bank Street, Sheffield.

Premier Electric Welding Co. (Leith), Ltd. (10,979).—Private company. Registered in Edinburgh February 20th. Capital, £8,000 in £1 shares. To carry on the business carried on by the North British Electric Welding Co. (Eastern), Ltd. The subscribers (each with one share) are: J. G. de O. Coke, Bank Buildings, St. James' Street, London, S.W.1, Captain, Royal Navy (retired); A. L. Haggerty, Bank Buildings, St. James' Street, London, S.W.1, company secretary. The first directors are not named. Remuneration £100 each per annum. Secretary: A. L. Haggerty. Solicitors: Bircham & Co., 46, Parliament Street, S.W.

Rashleigh Phipps & Co., Ltd. (164,318).—Private company. Registered February 20th. Capital, £50,000 in £1 shares (5,000 employés). To take over the business of an electrical engineer and manufacturer carried on by A. Rashleigh Phipps at 147, Oxford Street, W. The subscribers (each with one share) are: A. Rashleigh Phipps, 58, Fitzjohn's Avenue, N.W.3, electrical engineer; W. A. Edelstein, 3, Chapel Road, W.13, electrical engineer. Permanent governing director: A. Rashleigh Phipps. Solicitors: Percy Robinson & Co., 15, Great Marlborough Street, W.

Sphinx Manufacturing Co., Ltd. (164,366).—Private company. Registered February 21st. Capital, £50,000 in £1 shares (15,000 preference). To carry on the business of manufacturers of and dealers in sparking plugs and terminals, magnetos, electric motors, accumulators, and storage batteries, carburetters, &c. The first directors are: H. G. Longford, Tresco, Barnt Green, Worcs.; W. A. Clark, Goldthornes, Trafalgar Road, Moseley, Birmingham. Registered office: 242, Bradford Street, Birmingham.

British Scientific Apparatus Manufacturers, Ltd. (164,339).—Private company. Registered February 21st. Capital, £3,000 in £1 shares. To carry on publicity and propaganda, with a view to introducing, making more widely known, and increasing the sale of articles manufactured by members; to acquire showrooms and display scientific apparatus of British manufacture, to promote export trade in British-made scientific apparatus, instruments and appliances used for chemical, medical, surgical, electrical, nautical, aeronautical, meteorological, mathematical, photographic, and other purposes. The first directors are: C. Beck, 34, Upper Addison Gardens, Kensington, optician; M. B. Field, Nancekake, Bearsden, Dumbartonshire, nautical instrument manufacturer; F. C. Knowles, 16, Beaconsfield Road, Lammas Park, Ealing, W.5, electrical engineer; R. Miall, Chilton Croft, Wendover, scientific instrument manufacturer; H. T. Tallack, Rocklands, Fairfield Road, Croydon. Registered office: 6, Moorgate Street, E.C.

Alabaster Lighting Ware Co., Ltd. (164,377).—Private company. Registered February 23rd. Capital £12,000 in £1 shares. To carry on the business of dealers in electric and other fittings, especially fittings in which alabaster forms a part. The subscribers (each with one share) are: G. Vale, St. Andrew's Road, Caversham, Reading, secretary; S. S. Galsworthy, 15, Newman Street, Oxford Street, W.1, director. Each of the following companies, viz.: Best & Lloyd Co., Ltd.; Edison Swan Electric Co., Ltd.; Evered & Co., Ltd.; Galsworthy, Ltd.; General Electric Co., Ltd.; and F. & C. Osler, Ltd., may, so long as it holds 1,000 shares, appoint a director. Registered office: 84, Colmore Row, Birmingham.

Ballinrobe Electricity Supply Co., Ltd. (4,907).—Private company. Registered in Dublin February 13th. Capital £5,000 in £10 shares. To carry on the business indicated by the title. The directors are: Rev. E. A. Dalton, St. Mary's, Ballinrobe; P. D. Daly, M.D., Ballinrobe; T. Fitzpatrick, Ballinrobe, provision merchant; T. M. Scott, Ballinrobe, civil engineer; J. B. Staunton, Ballinrobe, provision merchant. Secretary: J. B. Staunton. Registered office: Abbey Street, Ballinrobe, Co. Mayo.

Radio Engineering Co., Ltd. (164,409).—Private company. Registered February 23rd. Capital, £5,000 in 5s. shares. To carry on the business of mechanical and electrical engineers, instrument makers, &c. The subscribers (each with one share) are: H. E. Straker, 47, Nelgarde Road, Catford, S.E.6, secretary to a limited company; F. H. B. Frere, 21, Wakefield Road, S. Tottenham, N.15, gentleman. The first directors are not named. Solicitor: J. Hoare, 3, Crooked Lane, E.C.

Dodds Finlay & Co., Ltd. (10,982).—Private company. Registered in Edinburgh February 21st. Capital, £5,000 in £1 shares. To carry on the business of electrical and mechanical engineers, machinists, wheelwrights, tube makers, bolt and nut manufacturers, manufacturers of cycles, &c. The subscribers (each with one share) are: T. S. Dodds, Leavenview, Fauldhouse, Linlithgowshire, engineer; R. M. Finlay, Myrtlebank, Fauldhouse, Linlithgowshire, engineer; J. Dodds, Leavenview, Fauldhouse, Linlithgowshire. The first directors are: T. S. Dodds, R. M. Finlay, J. Dodds, and G. S. Dodds, Cambuslang. Secretary: J. Dodds. Registered office: East End Engineering Works, Fauldhouse.

Hall Brothers (Manchester), Ltd. (164,574).—Private company. Registered February 27th. Capital, £10,000 in £1 shares. To take over the business of manufacturing, electrical, and mechanical engineers, millwrights, and machinists carried on by W. Hall and S. E. Hall at 11a and 11b, Eastnor Street, Old Trafford, Manchester, as "Hall Brothers." The first directors are: W. Hall, 11a and 11b, Eastnor Street, Old Trafford, Manchester, engineer; S. E. Hall, 11a and 11b, Eastnor Street, Old Trafford, Manchester, engineer; H. Ratcliff, Park Road, Timperley, Cheshire, engineer. Solicitor: S. Bishop, 23, Fountain Street, Manchester.

Dickinson & Thompson, Ltd. (164,527).—Private company. Registered February 26th. Capital, £2,000 in £1 shares (1,000 8 per cent. cum. pref.). To carry on the business of electrical engineers, founders, &c., and to enter into an agreement with R. G. Thompson and W. Dickinson. The first directors are: R. G. Thompson, The Briars, Benhill Road, Sutton, Surrey; W. Dickinson, 9, Grange Road, Clapham, S.W.; D. L. M. Thompson, 71, Endell Street, Holborn, W.C.; N. F. Thompson, 92, Dale Street, Birmingham. Registered office: 51-2, Chancery Lane, W.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

City of Freetown (Sierra Leone) Electricity Co., Ltd.—Return dated December 31st, 1919. Capital, £15,000 in £5 shares. 200 shares taken up. £1,000 paid. Mortgages and charges nil.

Consolidated Signal Co., Ltd.—Return dated January 1st, 1920. Capital, £425,000 in £1 shares (220,000 preferred and 205,000 ordinary). £14,195 preferred and 150,548 ordinary shares taken up. £52,839 paid on 24,999 preferred and 27,840 ordinary. £311,904 considered as paid on 189,196 preferred and 122,708 ordinary. Mortgages and charges nil.

Cape Electric Tramways, Ltd.—Capital £500,000 in £1 shares. Return dated December 31st, 1919. 491,222 shares taken up. £91,222 paid. £400,000 considered as paid. Mortgages and charges £276,300.

Electro-Coil Production Co., Ltd.—Debentures for £600, registered January 28th, 1920, charged on the company's undertaking and property, present and future, including uncalled capital.

Mersey Power Co., Ltd.—Particulars filed January 30th, 1920, of £100,000 debentures, charged on the company's undertaking and property, present and future, including uncalled capital, subject to charge for £300,000, amount of present issue being £20,000.

Tramways Supplies, Ltd.—Mortgage on pieces of land at Leeds and buildings thereon, registered February 3rd, 1920, to secure £6,000. Holders: Leeds Provincial Building Society, Leeds.

White & Poppe, Ltd.—Satisfaction registered February 4th, 1920, of charge for £10,000, registered November 20th, 1907.

Wycombe (Borough) Electric Light & Power Co., Ltd.—Debentures for £10,000, registered February 5th, 1920, charged on lands, buildings, machinery, works, plant, &c., and the company's undertaking and property, present and future, including uncalled capital.

CITY NOTES.

St. James' & Pall Mall Electric Light Co., Ltd.

Mr. W. Leaf presided at the annual meeting held on February 24th. He said that the past year had been a remarkable one. In the revival of trade the electrical trade had had its full share, and the company's main difficulty had been to cope with the fresh business that had been pouring in and was still doing so. The units sold increased by 15 per cent. and the revenue by about 30 per cent. They had not raised their prices since September, 1918, but during the whole of 1919 they had had the benefit of the increase that then came into force. The cost of generation and distribution had risen from £95,105 in 1918 to £116,763 in 1919. They now drew from the Central Co. all but about 2½ per cent. of their supply. The growth of the business had involved large obligations in the extension of the Grove Road station. They had endeavoured to keep that station up to date and well in advance of requirements, and but for the foresight of their engineers and managers, they would have been overwhelmed this winter by the calls that had come. They had further requirements pressing hard. They were already giving a supply in bulk to the Chelsea Co., and it was probable that before long they might be called upon to render assistance to other important undertakings unable to meet the heavy demands. They had been pushing on with the large extension of the Central Co., but there had been delays beyond their control in the delivery of the new 10,000 kw. set on which they were dependent for next year's supply. The fresh demands had, however, made it essential that they should order yet another 10,000 kw. set, and push on with building extensions in the form of a new boiler house. They had in hand an extension which would have been regarded only a few years ago as a complete new generating station of the first order. This had involved financial commitments of very large amount, and the way in which the cash was to be provided had been a matter of serious preoccupation to them all. The moment was singularly unfavourable for public borrowing in the form of either debentures or shares, not only because of the high rate of interest now required, but because the short and uncertain tenure of their occupation to them all. The moment was singularly unfavourpossibly suggest them. Under these circumstances, they had to provide the money from their own resources, and they had felt bound, therefore, to keep a large amount of the profits in hand. It was for this purpose that, in the first place, they

wished to extend the borrowing powers up to £300,000, the total nominal capital of the company. They wished to have a little recourse to loans as possible, and to provide what they had to find out of their own money in hand. Their resources were to some extent locked up in the form of investments. It might be necessary to realise part of them and invest the proceeds in the business. They had hitherto taken them at cost price, on the ground that they did not expect to realise before the termination of their life in 1931, but the time had now come when they must revise that view, and adapt themselves to altered conditions. They had, therefore, decided to add to the depreciation account the whole sum required to write down these securities to their market value on December 31st last, and for this purpose had set aside £14,728, which made them safe if the necessity should arise, while, if there should be a recovery from the present low market values, as one hoped must be the case some day, this would all come back to them as a realisable reserve. In any case it was, of course, an addition to the resources which would be of material assistance in helping to make the necessary advances to the Central Co. before they had to borrow from the bank. They had raised the dividend from 10 per cent. to 12 per cent., the dividend of the year before the war. They would be returning to consumers on their current quarter's bills a small amount in consideration of the reduction of 10s. on the price of coal, and shortly they would be able to announce a concession which would have the effect of reducing the cost of supply to consumers. The outcome of these conferences in connection with the Electricity Supply Bill had been the formation by the companies in the West-End group, including the Charing Cross Co., of a small private limited company, with a capital of £50,000, for the purpose of drawing up a scheme for the electrical supply of London. That company was intended to form the nucleus of a general combination of all the London companies. There was a good prospect that it would succeed in this object, and would end by including all the companies, and the presentation of one common scheme. The municipal authorities had got out a scheme of their own, which would also be put before the Commissioners, so that they would have a straight issue between public and private supply. There would be plenty of work for all who were engaged in the electrical industry in the coming year. The report was adopted, and later a resolution was passed increasing the borrowing powers of the directors.

Westminster Electric Supply Corporation, Ltd.

Lord Downham, in the speech which was read in his absence, through illness, at the annual meeting on February 25th, said that the receipts had increased by £76,000 and the expenses by £39,000. The latter was largely due to increased cost of coal, materials, salaries and wages. Their stocks of coal were now very greatly depleted, and urgent representations had been made to the Coal Controller. The present average price of coal to the company was 39s. per ton. They burned 39,000 tons, and the increase over last year cost £12,000. In September last they notified an increase to lighting consumers of ¼d. per unit as from January, 1920, but during the last quarter of the year an unexpected and very welcome increase in output occurred, owing no doubt largely to the removal of the restrictions on supply, so that the receipts during that quarter were the largest they had ever had in any similar period. They came to the conclusion that the increased charge from January 1st should not be made; in a few cases accounts had been issued at the increased rate, but the necessary adjustments would be made when the next accounts were sent out. The balance of the debentures were to be repaid on the following Monday, and the preference shares would then be practically in the position of a first charge on the undertaking. Orders were placed for new generating plant early last year, but owing largely to the moulders' strike it had not yet been delivered. They hoped to receive it before next winter's load came on. After referring briefly to the Electricity Supply Bill and the appointment of the Commissioners, the Chairman said that they had associated themselves with other London companies in putting forward a scheme for the supply of electricity to the London area, and the engineers were now preparing it, which, if approvad, would be put before the Electricity Commissioners. Clause 8 of the Act said that one of the duties of every joint electricity authority constituted under the Act was to provide or secure the provision of a cheap and abundant supply of electricity within its district. Finance, however, would be the great difficulty. When they considered that in London 42 per cent. of their total costs for generation and supply of electricity were due to capital charges, and that the construction of generating stations would be, at present prices, approximately from £25 to £30 per KW.—the cost of the erection of a large station, say, of 200,000 KW. would therefore be some five or six millions, to which had to be added the cost of mains and transforming plant—they would readily see how important it was that the companies should utilise their existing resources to the largest possible extent compatible with efficiency and economy. They had in the station of the Central Electric Co. at Grove Road a station that compared very favourably with the best in the country, and every care had been taken that it was kept quite up to date. Orders had been placed for more generating machinery of a much larger size than they had heretofore used, and this would still further add to its efficiency, and enable it to meet the great demands for supply in bulk which appeared to be coming upon it. Mention was made in the King's Speech of the proposal that a further Bill was to be brought forward by the Government. They did not know what the nature of this new Bill might be. The Government would be well advised, considering the present condition of the finances of the country and the prevailing high taxation, to leave expensive schemes such as these, which would amount to 200 or more millions, to private enterprise and existing undertakers, under the guidance of the Commissioners. In any case it was to be hoped that the Commission, now that it was constituted, would be allowed time to examine into present conditions and advise as to the best way of dealing with them before new proposals were formulated by the Government. The meeting approved of a resolution increasing the directors' fees.

Liverpool Overhead Railway Co.

At the annual meeting held on February 24th, Mr. H. C. Woodward, who presided, said that railway nationalisation seemed to be hung up for the present. The one cheerful feature in their experience was the vitality and growth in their traffic, which, though greatly stimulated by the requirements of the war period, showed no falling off, as might have been expected, since the war ended. The traffic figures proved the immense value to the port and trade of Liverpool conferred by the Overhead Railway, and the directors regretted that circumstances entirely beyond their control prevented the shareholders from reaping their due reward in the shape of increased return on their invested capital. Extensive repairs were needed both to railway and tramway, but with materials difficult to procure and shorter hours being worked, progress with such was slow. A shareholder called attention to the condition of the tramway track, and in reply the Chairman said it was most difficult to get repairs done nowadays, or to get new rails. The company's tramway lease was running, to a close, and they would have to make a fresh arrangement with the Crosby Council as to its renewal. Until an agreement was arrived at they could not do much more than patch.

South Metropolitan Electric Light & Power Co., Ltd.

Mr. H. St. J. Winkworth presided at the annual meeting on February 25th, and said that the reduction of 8 millions in the units sold was entirely accounted for by a reduction in bulk supply, which was less than half what it was in 1918. This demand was steadily recovering, the returns of the last few months having shown a regular and continuous improvement. Owing to the falling off in bulk supply and to the increase in the lighting demand the average price obtained had risen from 1.58d. to 2.47d. The net results were satisfactory. For 1919 the gross receipts at the Lewisham showroom were £25,000, and there were 7,385 transactions. Coal cost £59,951, against £72,897, a reduction of £12,946, due to the smaller output. The total expenditure of the year was 58 per cent. of the receipts, as against 62 per cent. in 1918, but the amount carried to net revenue was £70,109, against £63,387 for 1918. The work of installing the larger and more efficient turbo-alternators at the power house was now completed. Certain plant, which was no longer of service, had been disposed of, and the capital account written down. The power house at Greenwich had now been brought up to date, the older plant having been replaced by modern plant of high efficiency. The business of the West Kent Co. had been adversely affected by the reorganisation of works and factories, to which a supply was being given, from war to peace requirements. After referring briefly to the Electricity Supply Bill and to the resignation of Mr. H. W. Bowden, the speaker said that the prospect for the current year was favourable. There was marked activity in all sections of the business. On the other hand, the increased cost of machinery, mains and materials, the abnormal time for delivery, and labour unrest were very serious handicaps. Several new housing schemes were under consideration on estates in the company's area of supply, and the company was in negotiation with the L.C.C. and the local authorities concerned with a view to the installation of electricity in the proposed buildings.

Underground Electric Railways Co. of London, Ltd.

The receipts during 1919 were £692,364, a decrease of £67,901. Deducting directors' and other fees and expenses £10,116, income tax £13,036, loss on foreign exchange in respect of coupons £67,932, and commission and discount on issue of 5 per cent. three-year notes £10,674, there remains £101,758, an increase of £20,102, plus £36,693 brought forward. The interest on 4½ per cent. bonds, 5 per cent. three-year security notes, amount paid under guarantee on C.L.R. assented stocks, and interest on 6 per cent. first cumulative income debenture stock, absorb £242,643. There are paid 3 per cent., plus income tax, for the June half-year, and 1 per cent., plus income tax, for the December half-year, on the 6 per cent. income bonds, requiring £361,717, leaving £22,939. The report contains a summary of the results of the associated companies. It is stated that the Metropolitan District and the London Electric Railway Companies have, between them, ordered 140 additional carriages, and jointly ordered an additional 15,000 KW. turbo-alternator for the Lots Road generating station at Chelsea. A new subway is being constructed at the Charing Cross station for the purpose of improving the exchange facilities. The L.G.O. has ordered 500 omnibuses

of an improved type. The L.U. and the M. Elec. Tramway Co.'s have reconstructed considerable portions of their tramway tracks. The L.U.T. has completely overhauled the whole of its rolling stock. The Associated Equipment Co., Ltd., is extensively engaged in the manufacture of commercial lorries; the output for 1919 was £2,732,990, and orders for £1,600,188 are now on the books. The output was only 28 per cent. for the L.G.O. and 72 per cent. for outside customers.

Tramways, Light & Power Co., Ltd.—Viscount Chilston presided at the meeting of this company held on February 27th. After referring to the various undertakings of the company, he said that in July last shareholders were informed that in order to cope with the large demand for electricity a new generating station was to be erected on the Avon for the Leicestershire & Warwickshire Electric Power Co., and extensions to other power stations and cable systems of all the companies were necessary. The extension works then contemplated were in progress, and certain works, including the Avon power station, were nearing completion. The directors were about to make an issue of 247,900 additional ordinary shares for payment towards these extensions works. The high prices of fuel had been felt by all power users, as well as by power companies, and the effect had been to create an unprecedented demand for a supply of electrical energy to-day. Industrial power users were clamouring for a supply owing to the costs per H.P. of the small separately-owned plants having increased in greater ratio than the costs of the large central supply authorities. By the end of this year the company should have business which would produce a net revenue of about £80,000 per annum. They were very satisfied with the progress of the business at the present moment, and had every reason to anticipate a successful year.

Northampton Electric Light & Power Co., Ltd.—Satisfactory progress in spite of changing industrial conditions and the increasing costs. The Hardingstone Junction generating station began to come into operation in the spring of 1919, and nearly the whole of the company's output is now generated there. The anticipated economy in generating costs at the new station is being fully realised. 50,000 "B" shares were offered for subscription in October at 20s. 6d., and the issue was over-subscribed. The company has acquired control of the Wellingborough Electric Supply Co., Ltd., on very advantageous terms. The company began in November to give a permanent supply of all the current required for the Northampton Corporation tramways. Lighting and heating additions: equivalent 10,164—32 watt lamps (total 109,570). H.P. of motors increased from 6,298 to 6,950, of which 4,434 H.P. are let out on hire. Units sold increased from 6,233,019 to 6,589,108. £9,000 to depreciation fund. £4,000 spent entirely out of income during 1919 for removal of machinery from the old to the new generating station. After paying 5 per cent. preference dividend and 7 per cent. on the ordinary (as against 6½ per cent. for 1918), £1,110 is to be carried forward.

London Electric Supply Corporation, Ltd.—The report for 1919 presented at the meeting referred to here last week showed a profit of £95,240, against £78,376. Adding £10,367 brought forward, less interest on temporary loan, &c., £1,287, the total was £104,351. Debenture interest £23,494, debenture sinking fund, £16,580; 6 per cent. preference dividend, £26,952; 9½ per cent. dividend on the ordinary shares, £8,325; reserve, £12,500; contingencies, £5,000; carried forward, £11,500. Units sold 42,907,637, as against 46,357,227 in 1918; total costs per unit sold 1.17d., against 1d. in 1918. Average receipt per unit sold (lighting and power) 1.60d., against 1.35d.

General Electric Co., Ltd.—At an extraordinary general meeting held on Monday the resolutions passed on February 14th (Elec. Rev., February 20th, p. 247) were confirmed.

The prospectus is to appear to-day (Friday) inviting subscriptions for the issue of 1,600,000 7½ per cent. "B" cumulative preference shares of £1 each at par, and 400,000 ordinary shares of £1 each at 28s. per share.

Rushden & District Electric Supply Co., Ltd.—Number of consumers advanced from 179 to 298. Maximum load 365 KW., increase 46 KW. Units sold 607,028. Dividend for the year 6½ per cent., as against 5 per cent. for 1918. £356 carried forward. Auxiliary plant now being installed to keep pace with demand.

Direct Spanish Telegraph Co., Ltd.—Dividend at the rate of 10 per cent. per annum, less tax, on the preference shares; 5 per cent., free of tax, on the ordinary, and a bonus of 3 per cent., free of tax, making with 2 per cent. paid in October last, 10 per cent. for the year.

Prospectus.—*Yorkshire Electric Power Co.*—The list of applications was to close on or before March 3rd in an issue of £230,000—5½ per cent. redeemable debenture stock at 88 per cent., and of £400,000 in 40,000 £10 shares at par. The need for the new capital was explained in the report of the speech at the annual meeting.

Bournemouth & Poole Electricity Supply Co., Ltd.—Final dividend of 7 per cent. per annum, less tax, on the ordinary shares, making 6 per cent. for the year.

Brazilian Traction, Light & Power Co.—Quarterly dividend of 1½ per cent. on the cumulative preference shares.

Electro Bleach & By-products, Ltd.—The directors of this company received an offer from Messrs. Brunner, Mond and Co., Ltd., to purchase from the shareholders individually all the preference and ordinary shares in the company by allotment of shares and payment of cash as follows: For every two Electro Bleach preference shares one Brunner Mond ordinary share and 8s.; for every two Electro Bleach ordinary shares one Brunner Mond ordinary share and 3s.; for every odd preference share 25s.; for every odd ordinary share 22s. 6d. The sale of the Electro Bleach shares on the above basis will be ex the final dividend for the year 1919. The annual meeting has been postponed pending a decision on the proposed exchange, and should the exchange be accepted the directors will recommend final dividends making with the interim dividends already paid 7 per cent. on the preference shares and 14 per cent. on the ordinary shares for the year 1919. The Brunner Mond shares exchanged as above will be entitled to the same dividends as the existing Brunner Mond ordinary shares as from January 1st, 1920. The Electro Bleach directors recommend the acceptance of the offer.

Notting Hill Electric Lighting Co., Ltd.—The report for 1919 shows that out of 5,278 consumers 16 are supplied at 200 volts. The equivalent 30-watt lamps connected increased from 259,074 to 280,087. The available profit is £32,759. Of this £3,000 is put to depreciation, renewal, and reserve fund, £3,000 to special reserve, £1,792 is required for debenture interest, Kensington & Notting Hill joint debenture stock charges are £3,771; income tax £5,434; to be distributed to staff under co-partnership scheme £356. Preference dividend 6 per cent. Dividend on the ordinary shares 8s. per share, less tax, to compensate shareholders for loss in recent years. (The dividend on these shares after the capital arrangement in 1911 was at the rate of 5s. per share, but during the war it was reduced to 3s., and in 1918 it was passed altogether.) To be carried forward £1,784. Units generated 3,426,482; units sold 2,323,557; expended in distribution, transformers, and accumulators 1,085,925. Mr. A. E. Franklin has been elected chairman in place of the late Sir Wm. Crookes.

Torquay Tramways Co., Ltd.—Mr. L. B. Schlesinger presided at the annual meeting on February 27th, and said that the results of working were very satisfactory. The financial position of the company was quite strong. The traffic revenue was £8,200 better than for 1918, but operating expenses increased by £6,449. Passengers carried increased by 842,000, and made a record. They now had under consideration an application from the Transport Workers' Federation for an increase of wages. For the current year the receipts so far had been well maintained. They had ten omnibuses on order for connecting Torquay with Newton Abbot, Teignmouth, Dawlish, &c. In view of the high cost of labour and material close attention must be paid to the reserve and renewal account. The dividend was 8 per cent. against 7 per cent. for 1918.

Stock Exchange Notices.—The Committee has been asked to allow the undermentioned to be officially quoted:—

Babcock & Wilcox, Ltd.—500,000 ordinary shares of £1 each, fully paid (Nos. 1,660,001 to 2,160,000).

Lancashire Power Construction Co., Ltd.—400,000 six per cent. (income tax free up to 6s. in £) cumulative convertible first preference shares of £1 each.

Westminster Electric Supply Corporation, Ltd.—39,953 ordinary shares of £5 each fully paid (Nos. 310,101 to 350,054).

The committee has ordered the undermentioned to be officially quoted:—

Melbourne Electric Supply Co., Ltd.—£12,674 additional consolidated ordinary stock. 20,000 7 per cent. first cumulative preference shares of £5 each, fully paid (Nos. 60,001 to 80,000).

Metropolitan Electric Supply Co., Ltd.—Capital expenditure during 1919 £53,805, making it £2,396,921. Gross revenue £413,059, an increase of £64,333. Working expenses £242,623, an increase of £34,510. £69,486 to depreciation and reserve. Balance to credit of net revenue £100,951, plus amount brought forward and interest, &c., on investments, £119,510. After deducting debenture interest and preference dividend, and paying a total of 6 per cent. for the year on the ordinary shares, £4,441 is to be carried forward. New connections in 1919, 2,867 KW., making 45,426 KW. Meeting, March 9th.

Kensington & Knightsbridge Electric Lighting Co., Ltd.—During 1919 the number of houses and shops connected increased by 236 to 5,409, and the equivalent lamp connections by 30,604 to 603,219. Units sold 4,627,529. Net profit £13,529 plus £543 brought forward. After paying the preference dividend and 7 per cent. for the year on the ordinary shares, £1,223 is to be carried forward. The report contains references to the Electricity Supply Bill similar to those in the reports of the Westminster and other companies.

Canadian General Electric Co., Ltd.—Quarterly dividend 2 per cent., and bonus 2 per cent., on the common stock; and at the rate of 7 per cent. per annum on the preference for the half-year.

Vickers, Ltd.—Final dividend for 1919 of 2½ per cent. on preferred 5 per cent. stock, less tax, 2½ per cent. on 5 per cent. preference, less tax, and of 2½ per cent. on cumulative preference, free of tax

American Telephone & Telegraph Co.—According to the *Times* New York correspondent, stockholders are to meet on March 30th to approve the increase in the capital from £100,000,000 to £150,000,000. None of the new stock will be offered at present.

British Aluminium Co., Ltd.—It is stated that the directors have decided to make a distribution out of the reserves by the issue of two fully-paid ordinary shares for every three ordinary shares now held.

Brompton & Kensington Electricity Supply Co., Ltd.—Final dividend on the ordinary shares at the rate of 17 per cent. for the half-year, making 12 per cent., less tax, for the year. £1,230 carried forward.

Newcastle & District Electric Lighting Co., Ltd.—Dividend at the rate of 4 per cent. for the year, less tax.

Bruce Peebles & Co., Ltd.—Dividend 7½ per cent., less tax, on the ordinary shares for 1919.

STOCKS AND SHARES.

TUESDAY EVENING.

THE Stock Exchange has arrived at a halting place. Half-a-dozen reasons can be put forward to account for the slackening-off of business and the check thrown upon enterprise. The principal may be deemed the diversion of money into trade channels. Following this, the recent evidence in connection with the proposed tax upon war gains has seriously disturbed the mind of the public investor, who, seeing the prices of his war stocks steadily falling away in value, has begun to ask with unmistakable anxiety whether the Government have a scheme on hand which will amount to partial confiscation of national savings. The Budget looms in the near distance, and makes a third reason for caution on behalf of the capitalist, large and small. Other causes could be furnished to account for the depression that has developed in most markets, a depression deepened by lack of fresh buying orders. The buoyancy so discernible in the markets during the first few weeks of the year has given place to a more cautious feeling altogether, and people are inquiring whether shares are worth the money asked for them, instead of being content to buy on vague tips that the prices are sure to go up.

The electricity supply market would doubtless feel much more considerably the effect of the good dividend announcements, were it not for this prevalent dullish sentiment. Dividend results are certainly good, as those already chronicled in these pages have shown. The City of London dividend and bonus make 5 per cent. more than was paid a year ago, although the dividend itself of 10 per cent. is but 2 per cent. higher than that for 1918. In our tables of yield, we work out our calculation on a 10 per cent. basis, though it has to be remembered that there are still three years' extra dividends to be made up, and that on this account there may be a further 6 per cent. bonus to come by-and-bye. The Charing Cross dividend of 7 per cent. is 3 per cent. better than that for the corresponding period. The London pays 2½ per cent. on its ordinary shares, against nothing. Improvements of 2 per cent. are shown by the St. James's and the Westminster companies. Increases of 1 per cent. are declared by the Chelsea, County of London, Kensington, Metropolitan and South London companies. The Notting Hill ordinary dividend of 8s., being 800 per cent. as against nil twelve months back, furnishes the star turn of the programme, and the shares of the last-named have risen to 35s., on the announcement, a jump of about 10s. a share.

The rest of the list is not much better than firm, but shares are difficult to buy, and with dividends included in the current prices, it is natural that holders should be reluctant to part with shares which they have kept, many of them, through the bad times, in the expectation that something will happen of the sort upon which we are now commenting. Moreover, there is scope for further improvement, and without waxing unduly optimistic, it is reasonable to expect that the present rates of dividend, excellent as they are compared with recent achievements, do not represent the full advantage which shareholders in the companies should derive by reason of post-war conditions.

Manufacturing shares hold their ground. Underwriting agreements in respect of the forthcoming new issue by the General Electric Co. were in circulation early this week, and the terms are one new share at 28s. for every three old. Edisons hold their price at 26s., and Electric Constructions are another hard spot at 25s. It is announced that Brunner Monds, following their acquisition of the Castner Kellner Co., have made a bid for the Electro-Bleach & By-Products, Ltd. Brunner Monds offer one ordinary share in their company and 8s. in cash for every two Electro-Bleach preference, and for every two ordinary, one Brunner Mond ordinary and 3s. in cash. The directors of the Electro-Bleach undertaking strongly recommend acceptance of the offer, and holders of at least 75 per cent. of each class of share must accept within four weeks of February 25th, otherwise Brunner Mond & Co. may withdraw their offer. Castner Kellner's hold their price of £2. Home Rails are weak. Central London Assented ordinary is down 2, allowing for deduction of the dividend. Underground Incomes, ex £1 dividend free of tax, are down to 74. There is no courage left in the market or in its occasional supporters.

Eastern Extensions, Globes, and Westerns have all receded 10s. owing to the dulness prevailing amongst investment stocks. Globe preference, on the other hand, are ½ higher, and Great Northern Telegraphs moved up 30s. to 24, a movement the likelihood of which was pointed out here last week, and counteracting to some extent the steady decline which has been taking place during the past few weeks. Marconis are also a better market at 3½. Callender's receded to 9½, and Telegraph Constructions are again £1 down at 38, the dividend disappointment still bringing in a few sellers. Automatic Telephones remain about 20s., shares changing hands a few pence either side of the round sovereign. British Aluminiums have risen to 2½, and are the main feature of strength in their particular department. Amongst other industrials, the feature is the way in which prices in the iron, coal and steel market are advancing, in consequence of the bright outlook that opens out to the industry. Engineering shares, however, have hardly participated so far.

In the Colonial and foreign section, Canadian General Electric Common gained several points at 126. British Columbia stocks are weak, and Mexicans show further heaviness, the 6 per cent. bonds of the Mexico Tramways Co. shedding 4 points. There is little doing amongst Anglo-Argentine Trams. New issues continue to pour out in ceaseless streams. The offer of the Yorkshire Electric Co.—particulars were given in this column last Friday—made its appearance a day or two ago. There are several other electrical issues in course of preparation for the investor.

The price of rubber has gone back to 2s. 7d. per lb.; and interest in the principal shares is meagre.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1918.	Dividend 1919.	Price March 2, 1920.	Rise or fall.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	8	—	6½	—	£6 7 0
Charing Cross Ordinary	4	7	9⅜	—	9 6 8
do. do. do 4½ Pref.	4½	4½	2⅜	—	8 8 8
Chelsea	3	4	3⅜	—	6 3 1
City of London	8	10	14	—	7 2 10
do. do. 6 per cent. Pref.	6	6	9⅜	—	6 4 8
County of London	7	8	6½	+ ½	8 2 3
do do. 6 per cent. Pref.	6	6	9	—	6 13 4
Kensington Ordinary	6	7	5½	—	6 18 4
London Electric	Nil	2½	11xd	+1/6	5 10 6
do. do. 6 per cent. Pref.	6	6	8xd	+3/-	8 11 6
Metropolitan	5	6	8⅜	— ½	7 14 10
do. 4½ per cent. Pref.	4½	4½	2⅜	—	7 16 6
St. James' and Pall Mall	10	12	6xd	+8/6	9 4 8
South London	5	6	9⅜	—	7 12 8
South Metropolitan Pref.	7	7	19/6xd	—	7 3 7
Westminster Ordinary	6	10	5xd	—	8 18 10
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	90½	—1	6 12 7
do. Def.	33/6	1½	10½	—	7 6 4
Chile Telephone	6	6	6½	—	*1 13 2
Cuba Sub. Ord.	7	7	10½	—	*6 13 4
Eastern Extension	8	10	19½	— ½	*5 2 7
Eastern Tel. Ord.	8	10	195	—	*5 2 7
Globe Tel. and T. Ord.	8	10	19½	— ½	*5 2 7
do. do. Pref.	6	6	9⅞	+ ⅛	6 3 1
Great Northern Tel.	2½	—	24	+1½	9 3 4
Indo-European	15	—	48½	—	6 13 4
Marconi	25	—	3⅜	+ ⅛	6 8 10
Oriental Telephone Ord.	10	—	2½	—	4 16 9
United R. Plate Tel.	8	—	8	— ⅛	*5 0 3
West India and Panama	1/8	—	14	—	5 11 1
Western Telegraph	8	10	21	— ½	*4 15 0
HOME RAILS.					
Central London Ord. Assented	4	4	47½xd	—2	8 8 6
Metropolitan	1	1½	21½xd	— ½	5 16 8
do. District	Nil	Nil	18	— ½	Nil
Underground Electric Ordinary	Nil	Nil	2½	+ ⅜	Nil
do, do. "A"	Nil	Nil	6/6	—	Nil
do. do. Income	5	—	74xd	—1	—
FOREIGN TRAMS, &c.					
Anglo-Arg. Trams. First Pref.	Nil	Nil	3⅞	—	—
do. do. 2nd Pref.	—	—	3½	—	—
do. do. 5 Deb.	5	5	68½	—	7 15 0
Brazil Tractions	—	—	5½	—	—
Bombay Electric Pref.	6	6	18⅞	+ ⅛	3 4 0
British Columbia Elec. Ry. Pfce.	5	6	62½	—1½	8 0 0
do. do. Preferrred	2½	3	53⅜	—⅜	9 7 0
do. do. Deferred	Nil	3	45½	—2½	6 11 10
do. do. Deb.	4½	4½	61½	—1	6 18 3
Mexico Trams 5 per cent. Bonds	Nil	Nil	37½	—5	Nil
do. 6 per cent. Bonds	Nil	Nil	25½	—	Nil
Mexican Light Common	Nil	Nil	2½	—	Nil
do. Pref.	Nil	Nil	8½	—2½	Nil
do. 1st Bonds	Nil	Nil	82½	—	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	—	86	—	*4 2 9
British Aluminium Ord.	10	—	2⅜	+ ⅛	4 14 1
British Insulated Ord.	13½	—	2/6	—	6 1 1
Callenders	25	—	9⅜	— ½	6 13 4
do. 6½ Pref.	6½	6½	42	—	6 16 10
Castner Kellner	20	—	4	—	—
Crompton Ord.	10	—	22/6	—	8 17 10
Edison-Swan, "A"	10	—	1½	—	6 0
do. do. 5 per cent. Deb.	5	5	77½	—	6 5
Electric Construction	10	—	1½	—	6 0
Gen. Elec. Pref.	6½	6½	12/6	—	6 13 4
do. Ord.	10	—	2½	—	*4 9 0
Henley	25	—	2½	—	6 0 0
do. 4½ Pref.	4½	4½	3½xd	+2/3	6 4 9
India-Rubber	10	—	16	—	*3 5 0
Met.-Vickers Pref.	—	8	3½	—	5 0 4
Siemens Ord.	16	16	30/6	—	*6 11 2
Telegraph Con.	20	20	38	—1	*4 5 0

* Dividends paid free of Income Tax.

THE BUYER AND BUYING.

(From a Salesman's Point of View.)

By "SALESMAN."

To one who has the good fortune (or otherwise) to be a salesman, Mr. McKinnon's article in a recent issue of the REVIEW*, coming as it obviously does from the pen of an "inside" man, is naturally of great interest.

Mr. McKinnon is not the first of his kind who, in the fullness of his heart, has set forth his idea of the qualities that go to make the "Admirable Crichton" of salesmen, but the writer does not recollect having encountered much in the way of criticism of the manners and customs of the buyer.

Perhaps this lack of criticism is due to the retiring, gentlemanly nature of salesmen, or it may be attributed to a spirit of caution, but in the humble opinion of the writer, the art of the buyer offers as wide a scope for the exercise of tact, politeness, &c., as does that of the salesman.

Now, in offering the following suggestions and criticisms for the consideration of buyers, due attention has been given to the fact that in some instances a would-be keen and courteous buyer is heavily shackled by the uncompromising and conservative attitude towards salesmen, taken up by his management; also there is that bugbear of the salesman known as the "contra" arrangement, which kills all efforts on the part of the buyer to introduce goods which are often better value than those of a similar nature supplied to the "contra" account.

Much might be written regarding methods of interviewing salesmen adopted by various firms, and in connection with this, let us consider the position of the salesman in relation to a firm with which he is trying to do business.

Now, unless a salesman be a born fool (and such do not exist long on the road) he will certainly not approach any firm without some ground for so doing, *i.e.*, he must be selling something which may prove of material use, or be cheaper than a similar article in daily use by that firm. Therefore it is obvious that it is to the advantage of the latter at least to give him a hearing, and that under circumstances which will enable him to explain himself properly, and not within hearing of competing salesmen.

One would think that all salesmen were thieves, or worse, to look at some of the interviewing traps which are a regular feature in the offices of many large firms even to-day. This abominable "trap" method is one of the most awkward and overtly insulting systems of interviewing known to the unfortunate salesman. Happily, however, these model booking offices are fast disappearing, and most firms of any standing have made far more congenial arrangements. Surely it should be possible to set apart a room to be used solely for the purpose of interviewing travellers. The room so reserved may be divided into two parts, one of which should be furnished with a few chairs and a supply of trade papers, &c., for the benefit of waiting travellers; the other section being devoted to the actual interviewing. Happily, many firms are adopting this arrangement, much to their advantage and credit as business houses.

Another stumbling-block to the salesman is the system of never granting interviews to travellers except by appointment. Now, assuming our traveller has to do with a firm of this stamp, he naturally writes for an appointment, and with what result? In nine cases out of ten his letter is ignored by the buyer, and should he get a reply, investigation will often show that it was prompted not by the buyer, but by some person, in the works perhaps, who was interested in his proposition.

Over and over again, a salesman will experience the joy of receiving a sharp letter from headquarters enclosing a communication from a firm, on his ground, requesting information as to a particular line, the advertisement of which has caught the eye of the buyer. The traveller immediately looks up his records and finds that he has tried that very firm perhaps three or four times, and been met each time with a blank refusal of an interview, as his proposition "does not interest us."

Would it not be possible for firms to have appointment cards printed stating clearly that if Messrs. Blank's representative cared to call at 11 a.m. on such and such a date he would be accorded an interview? The length of this interview would depend entirely on the ability of the salesman to interest the buyer in his goods, but it certainly should be part of the duties of a buyer to set apart so much time each day for such interviews.

Regarding the "contra" arrangement already mentioned in this article, the writer cannot forbear relating a recent personal experience.

A certain large firm, upon receipt of a circular letter calling attention to a particular article, wrote for prices *by return*. The quotation was duly forwarded, but nothing further was heard until the writer called upon the firm in person, and had an interview with the buyer. He was thereupon told that, while his prices were right, and the excellent quality of the goods offered was well known to the works engineer, it was quite impossible for this particular firm to pass him an order as they had "an arrangement with certain friends who took their goods." In other words, they had a "contra" account with their friends. Now, why on earth did this firm give all this trouble without the slightest intention of doing business?

Oh, ye travellers and salesmen! Look out for the "sample fiend" who asks for a sample of this and a piece of that, very often without any clear idea as to what tests are required. Say, for instance, one is selling electric lamps. Now, what is the use of supplying one lamp only, for test purposes? Ten to one the lamp is handled and fiddled with by half a dozen people before being put on test, and yet the writer has known a case where a certain type of lamp was absolutely turned down simply because one sample behaved badly on test, which it might easily do after having been shaken and turned this way and that by inquisitive clerks, &c. It should be stated that in this instance the buyer refused to order a dozen or so lamps for test, although such is the usual practice.

It is manifestly impossible for any buyer to be an expert judge of all the various goods which he is called upon to purchase for his firm, but he generally knows where to put his finger on a colleague who is in the position to give him expert advice and the samples a fair test. That this is not always done is due very often to petty jealousy or the fear of disclosing ignorance. It would be easy for any management to instruct the buyer to send all samples to various expert members of the staff, whose reports would be given due consideration when it came to a question of placing orders.

The "cheap" buyer is a nuisance to his firm, and is the prey of all manufacturers of shoddy stuff at cut prices. It has been proved over and over again that it is the falsest of policies to buy the cheapest goods simply because they are the cheapest, and yet there are hundreds of buyers who pride themselves on so doing.

The writer well remembers a case which came under his own observation where cheap buying eventually proved a most expensive business. In this instance certain gear was required for a switchboard, and inquiries were sent to half a dozen firms. The buyer, who was of an economical persuasion, to put it mildly, ordered up from the firm which sent in the lowest quotation, without referring the matter to those who could have

* ELECTRICAL REVIEW, December 26th, 1919, p. 804.

advised him better. Result, the gear was delivered in several separate lots, all hopelessly mixed up, and was of the very flimsiest description. Two well-paid men had to devote a day or more to the sorting of this rubbish, and the correspondence on the subject was endless.

The buyer who cannot say "No" is easily the worst type of buyer with whom the salesman has to contend. He will listen pleasantly to all one has to say, he will express great interest in samples, &c., and will bid one quite a touching farewell, promising faithfully to forward an order "in the course of a post or so." Then he will hie him back to his office with the express intention of forgetting all about it. A downright "No" is far preferable to this sort of thing, yet the type of buyer referred to is by no means uncommon; he is, however, very much disliked by salesmen.

No reasonable salesman objects to fair criticism of his goods always provided it *is* fair, and does not seem to echo the voices of competitors. Many valuable hints are often given in this critical spirit, and if the salesman be wide awake he will pass the information thus acquired on to his headquarters for the consideration of the management.

It is the querulous critic who views *all* new goods with a jaundiced eye, who can see no good in anything which differs from that which he is already buying; it is such as this that even the most persistent salesman will in time learn to avoid, and incidentally, of course, the hypercritic may therefore one fine day miss a good thing, and wonder why.

Who does not know the cheery buyer who will tell one in mournful accents that: "No, there is nothing for you to-day," but (in a delighted tone), "I have just given Messrs. So and So's man an order for £200's worth of stuff"—Messrs. So and So being, of course, one's competitors.

There is yet another type of buyer whose ways are a source of much trouble to the salesman. This buyer will obtain quotations for certain goods on the distinct understanding that the prices are good for acceptance within a certain period only. For no apparent reason whatever, our friend the buyer will hold his order back for several weeks after the time limit for that price expires, and will be mightily upset on receiving an intimation to the effect that "prices have advanced 50 per cent. since our quotation of the ——."

Lastly, every salesman knows the buyer who, by fair promises and a sympathetic mien, will draw out of him full particulars as to prices, &c., and will, upon the first opportunity, transmit this intelligence to a competitor with whom he (the buyer) may be on good terms. This may be good business, but it breeds distrust, and should the offending buyer at any time be forced to turn to a victim of such practice for help in a time of bad deliveries, &c., he will not receive much consideration.

In conclusion, the writer would say that, while undue interference with the buyer, by his superiors, is to be deplored, in the majority of cases a great deal too much is left to be decided by that individual's personal likes and dislikes, with the result that very often an unscrupulous salesman (there are such, sad to relate) will so ingratiate himself as to exclude his more honourable competitors.

THE BRITISH INDUSTRIES FAIR.

(*Continued from page 265.*)

BIRMINGHAM.

The comprehensive section of the Fair that was held at Birmingham (Castle Bromwich) under conditions that peculiarly favoured such an effort was representative of most of the staple manufacturing trades of the Midlands. Not all the district's manifold trades were represented, but it was symptomatic of the newer spirit of manufacturers that, with order books full beyond the immediate capacity of execution, a majority of the leading firms should be found making determined efforts to extend their markets, both at home and abroad. The majority of the most important industries of Birmingham and South Staffordshire had their mart at their door, and if it served no other purpose, the Fair afforded an opportunity for manufacturers to feel the pulse of the markets of the world, and to ascertain the descriptions of goods that will sell best there. All three sections of the Fair close to-day.

The promoters of the Birmingham section of the Fair were the Municipality and the Chamber of Commerce, and the details were worked out by a council consisting of leading business men, and including Mr. R. A. Chattock, city electrical engineer.

The stands, of which there were some 630, including about 90 devoted either exclusively or partly to electrical apparatus, were allocated on a plan which brought exhibitors in the same industry together, and to a considerable extent it was arranged that allied trades were near neighbours.

The electric fire and stove exhibits were much less fully representative than those of gas heaters, but there were some neat examples of electric fires and cooking ranges, whose ease of manipulation, cleanliness, and general efficiency need no elaboration. Electric heaters, radiators, and stoves were exhibited on 13 separate stands, while domestic electrical accessories and fittings were to be seen on 10 stands. On the lighting side, electricity had the premier position, and many firms showed beautiful and efficient fittings for use in public buildings, private houses, steamships, and for industrial lighting purposes. No fewer than 36 stands included electric lighting fittings, but only one stand was seen on which arc lamps were on view.

On the principle that measuring and weighing machines are of great importance in the matter of profit protection, the section of the Fair dealing with such apparatus was of much interest, and the exhibit of Messrs. W. & T. Avery, Ltd., Birmingham, which consisted of road weighbridges, solid and liquid weighing machines, various types of platform machines (in foreign standards), counter scales, counting machines, testing machines, &c., received well merited attention.

Messrs. Stewarts & Lloyds, Ltd., Birmingham, had a comprehensive exhibit of solid drawn and lapwelded steel pipes for all purposes, including an 84 per cent. lap welded steel pipe with a "Vulcan" joint for water power purposes; a high-pressure steam pipe for 350 lb. per sq. in. working pressure, a patent long sleeve welded joint, tramway poles, boiler tubes, and various kinds of coils, &c.

Firms that exhibited sparking plugs, cases, and adapters were Messrs. J. B. Brooks & Co., Ltd., Forward Sparking Plug Co., Apollo Plug Manufacturing Co., Ltd., Howard S. Cooke & Co., Sphinx Manufacturing Co., all of Birmingham, and C. Binks, Ltd., Manchester, Igna Engineering Co., Ltd., Dudley, and Firth-Brearley Stainless Steel Syndicate, Ltd., Sheffield.

The Lucas Electrical Co., Ltd., Birmingham, exhibited Thomson-Bennett magnetos suitable for all types of motor cycles, and also the "Magdyno" combined electric lighting and ignition set for motor cycles as described in our columns recently.

The British Lighting & Ignition Co., Ltd., Birmingham, showed "Blic" magnetos for cycles and small cars, and for large stationary gas engines.

Messrs. Siemens Brothers & Co., Ltd., Woolwich. This exhibit included the more generally employed forms of dry batteries and primary galvanic cells as used for all purposes, and formed a comprehensive collection of such batteries as manufactured by this firm. The company also showed various types of incandescent electric lamps.

Messrs. Ward & Goldstone, Ltd., Manchester, showed a wide range of their manufactures and supplies, among which were the following: high and low-tension automobile ignition cables, brass, nickel and aluminium armoured lighting cables, electric lighting flexible cords, tough-rubber sheathed cables, flexibles, bell wires, telephone wires, silk, cotton and enamelled instrument wires. Two sizes of country house lighting plant were also shown, one being the 350-watt set, comprising ¾-h.p. engine and belt driven dynamo, and the other a 3-h.p., 1,500-watt set, direct coupled. Switchboards for use with this plant were also shown. The T.R.S. wiring system consists of flexible conductors under a flat tough-rubber sheathed covering. This cable can be used for surface wiring, and is fitted in position by means of brass saddles, insulated with fibre. The T.R.S. patent connector box, which forms the really novel part of this system, enables the installation to be made without a soldered joint of any kind. The system does not require the skilled labour necessary to fit screwed tubing or casing, neither does it necessitate sinking in the wall or ceiling. The "Voltalite" self-generating electric cycle lamp was on view, and although this cannot claim to be a novelty, inasmuch as it has been manufactured now for some 15 years, it is still an article of considerable interest, and we understand the demand is greater than ever. "Volex" dry batteries were shown, and a large range of motor cycle lighting sets operated from Volex dry batteries. Among this range there is a simple headlamp lighting set, also the head and tail lamp lighting set, and the head, side, and tail lighting set. The dry batteries fit in a metal container, with the switchboard on top, and this metal container drops into the bottom of the side car, the wiring to the head, side, and tail lamps being provided with the outfit, and of a very simple nature. Many of these sets have been used one or even two years without the necessity of replacing the battery, which replacement can be made in a few minutes as the containers take the standard 4-volt "Volex Aero" dry battery. A variety of Izolex fuse boards, the firm's fuse units, main switches, and other ironclad switch and fuse gear, as well as such lines as pocket voltmeters, ammeters, switchboard type instruments, medical coils, and other novelties were also to be seen.

The Birmingham Private Telephone (New System) Co., Ltd., Birmingham, exhibited a large selection of automatic intercommunication telephones of various types, including the secret conversation, visual dial indication, &c., types. The "Laryngaphone," which is manufactured by the Telephone Manufacturing Co., Ltd., London, is a new form of telephone devised for rescue work in mines in conjunction with breathing apparatus. Its special feature is that it enables the worker to carry on a conversation although wearing a gas mask. Fig. 1 shows the complete mine rescue outfit. The

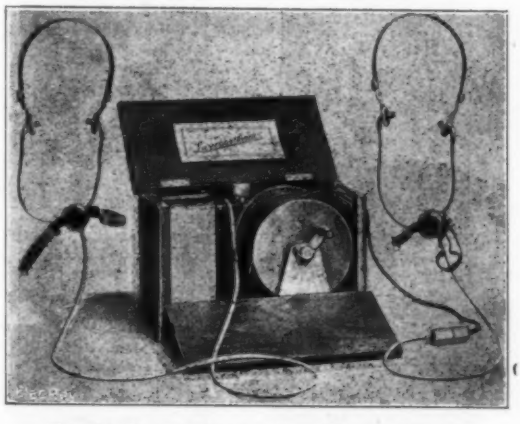

Fig. 1.—Laryngaphone Mine Rescue Outfit.

vibrations of the vocal cords during speech are collected by a transmitter strapped to the throat, which in turn reproduce corresponding vibrations in a receiver at each end of the line. The apparatus is also equipped with a signalling device, consisting of a Morse key and buzzer, which enables any prearranged code to be sent over the line should any failure take place in the transmitter. A lamp is also fitted which performs the double function of indicating the state of the line and repeating the Morse signals. Suitable drums are provided on which the flexible cable, specially insulated to withstand abnormal conditions, is wound; the apparatus can be used by two or more rescuers operating together. The transmitter and receiver are made as far as possible of aluminium, and are very light, the size being only 1¾ in. in diameter by 1¼ in. in length. The flexible cable runs between two rollers, and on the drums a handle is fitted for rewinding. The outfit is contained in a teak case fitted with an open hinged front and lid; its dimensions are 1 ft. 3 in. by 7 in. by 8 in., and the total weight is 14 lb. When the case is lifted an auto cut-out disconnects the battery. The signalling switch is operated by pressure of the lower jaw of the wearer. The combined transmitter and receiver is contained in a weather-proof case, and is adjustable against the larynx; a flexible tube conveys sound from the receiver to the ear, and by means of moulded longitudinal grooves in the ear tube free ventilation and equal air-pressure on the ear drum is obtained. A general diving equipment consists of a semi-automatic indicator switchboard and central battery situated in a position convenient to the air pump plant. The switchboard indicator switches correspond with the maximum number of divers who may, at any one time, be "down" together. Each diver and the pump attendant are respectively provided with a diver's equipment. The pump attendant connects the set he is wearing to the switchboard, and the cables passing through the various divers' airlines are also connected up to the line terminals on the switchboard. The operation of the switchboard is novel and deserves special attention. The visual indicators also act as automatic switches. Thus, when a diver signals up and drops his indicator, the falling of the indicator immediately switches his speaking circuit on to the operator, and as the operator is permanently connected to the switchboard he is bound to hear what the diver has to say. The signal is made by the diver dropping his lower jaw to the full extent, which operates the signal switch. If, on the other hand, the operator wishes to speak to the diver, he mechanically drops the appropriate indicator by depressing the corresponding switch control, and thus is able to immediately speak to the diver in question. Should one diver require the assistance of another he signals the operator who, by depressing the other man's control switch, enables both divers to converse freely (he overhearing the conversation), and they can be left in communication, if necessary, to aid their co-operation. In the event of an emergency the attendant, by depressing a button, drops all the indicator switches simultaneously and can thus speak to all the divers at once. The above are only a few of the utility points of the "Laryngaphone" diving outfit. To those intimately associated with the ramifications of the diving industry many other applications will suggest themselves.

Messrs. J. H. Tucker & Co., Ltd., Birmingham, showed accessories for lighting and power, ironclad gear, switchboards and switchgear generally. In the centre of the back wall of the stand was a handsome white marble board on which were mounted numerous examples of the switches, fuses and other gear used in switchboard building. Fuses of many different patterns and ranging in size from 15-amp. to 1,000 amp. were shown, whilst switches of the firm's "N.K." and "O.K." patterns were also shown in a variety of sizes from 15 amp. to 1,000 amp., and in single, double and triple pole, single throw and change-over and other forms. Battery regulating, shunt regulating and voltmeter switches were also shown. The firm also showed a complete standard accumulator switch board, consisting of ammeters, voltmeter, voltmeter switch, charge and discharge battery regulating switches, automatic battery cutout, main double pole switch and fuses for dynamo and also for lights mounted on enamelled slate for use in conjunction with batteries and lighting sets for country house lighting and similar purposes. A wide range of samples of ironclad switches and fuses for house, works and other industrial purposes were shown. The switches, shown in single, double and triple pole, varied in sizes from a 5-amp. ironclad and watertight to 100-amp., and were of the "turn," "push and pull," and other types. A special feature was the "Tucker" patent quick "make" and "break" ironclad switch, which was shown in two sizes—25 and 50 amps., and with and without D.P. fuses. The design of this switch case permits of it being used with either a large central tapped hole each end for the incoming and outgoing cables, or two smaller holes. This is effected by means of interchangeable and removable adapters, which can also be provided with recessed bodies and wood bushed holes for sealing hygroscopic cables and with watertight glands. A large number of different patterns of ironclad fuses were shown, switches for sunk and surface work, with plain, fluted and ornamental covers, with china and locked covers. One-way, two-way, two-way and "off" secret action combined switches and sockets were all shown in several designs and in a variety of finishes. Prominent was the firm's latest production in flat type switches, in which both a quick "make" and a quick "break" action is obtained. This switch is in size and actual appearance precisely the same as the ordinary (quick "break" only) flat type switch. In the lighting and power accessories section the firm showed samples of its lampholders, counterweights, ceiling roses, wall sockets and plugs, both ordinary ironclad and ironclad and watertight patterns, cutouts, round and oblong, bell pushes, porcelain connectors, 1, 2 and 3-pole B.C. and plug adapters, and many other similar articles.

The Austin Motor Co., Ltd., Birmingham. This exhibit included the glandless petrol pump, in section, showing the ingenious method by which all glands are done away with and leakage rendered impossible. Three sizes of generating plant for country-house lighting were shown in operation; the 0.75-kw. set was on view at the Ideal Home Exhibition, and was described in our pages at the time. The 3-kw. automatic set consists of a four-cylinder 6-h.p. engine direct coupled to a 27.5/22 ampere, 100/140 volt, 1,150 r.p.m., reverse compound-wound Siemens dynamo, both mounted on a cast iron bed-

plate. The engine is cooled on the thermo-siphon system, and the engine starts up on petrol; the change-over to paraffin is effected by hand, but similar equipments are built in which the change-over is automatic. In the case of this equipment, the pressure is kept constant by cell-adjustment, and not by a third brush as in the 0.75-KW. plant previously described. The 5-7-KW. automatic battery booster, fig. 2, consists of a twin-cylinder engine, 10-11-H.P., four-stroke, water cooled, direct coupled to a 5-KW., 46-ampere, 110-volt generator running at 800 R.P.M., which in its turn is coupled to a battery booster, separately excited for an output of +40/0/−10 volts, 46/80 amperes, the three machines being mounted on one cast-iron bedplate; both the generator and booster are by Submersible Motors, Ltd. On the left of the three-panel switchboard is a starting panel for taking energy from the battery and starting the set up by "motoring" the dynamo. The right hand panel has mounted on it a double pole, double throw switch to enable energy to be taken direct from the

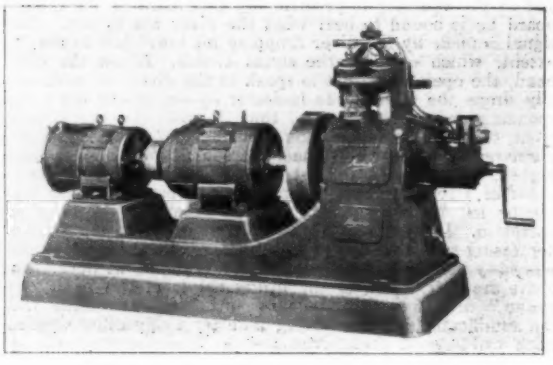

FIG. 2.—AUSTIN BATTERY BOOSTER SET.

battery, or from the battery and booster, or from the battery and booster in parallel with the dynamo. The centre panel is equipped for automatically shunt-regulating the booster so as to maintain constant loading on the dynamo at 46 amperes. This current will charge the battery in the event of there being no load on the system or will distribute its current between the battery and the load, or in the event of the load exceeding the output of the dynamo, then the dynamo current will assist the battery and provide current for the load up to a maximum of about 12 KW. at 110 volts. The plant has been designed with the object of using a small generating set to run at full load during the whole 24 hours, a large battery being installed to deal with the peak loads. The company is perfecting a system for running an electric lighting set in conjunction with a gas producer plant, utilising anthracite or peat as fuel. By this means it is hoped to be able to reduce the generating cost to less than 1d. per unit generated.

THE CHLORIDE ELECTRICAL STORAGE CO., LTD., Clifton Junction, exhibited several small accumulators, as well as motor-car batteries, as described in our last issue, and a storage battery, composed of 55 glass cells of the S.L.G.7 type, each containing 15 plates, for use in connection with country-house lighting. The battery had a capacity of 427 amp.-hours at the 10-hour rate, and was shown in operation, being charged by the Austin booster in the next stand and described above, and supplying energy to light two rows of exhibitors' stands.

LONDON.

THE EFANDEM CO., LTD., of Wolverhampton, exhibited a collection of dry battery refills for pocket lamps and torches, cycle and scout lamps, military and police lamps, hand lanterns, and reading lamps. Accumulators for the same purpose were also shown, interchangeable with the dry batteries. Many pocket lamp cases of exceptionally handsome finish in printed metal and other materials were exhibited, as well as a variety of small motor-car lighting accessories, &c.

THE SEMAPHORE ENGINEERING CO., LTD., London, showed a variety of dry batteries for refills, as well as complete pocket lamps and torches, cycle lamps, and portable battery lighting sets. Other exhibits included round two-cell batteries of the sack type, of which many of the No. 10 size have been supplied to the Post Office, and samples of "Solidite" insulating composition made by the company.

THE ORBIT ELECTRICAL CO., LTD., London, showed dry battery refills for pocket lamps and torches, &c.

MESSRS. HENRY HARVEY & CO., London, who specialise in all kinds of fancy goods made from sea shells, showed a selection of reflectors and shades for electric lamps of this material, which gives beautiful colour effects, especially when the lamps are alight.

MESSRS. A. CHASE & CO., LTD., Teddington, had an exhibit of tapping keys, sounders, buzzers, signalling lamps, and various types of small motors for battery working, suitable for the young amateur electrician, who by this means can add immensely to the interest and effectiveness of his Meccano set or model launch.

THE REMOLINE CO., London, exhibited pocket lamps and dry battery refills, electric toys and novelties.

MESSRS. ROSE BROS., London, had a varied exhibit of dry battery refills for torches, pocket lamps, hand lamps, &c., bell batteries, portable battery lighting sets, and signalling lamps. They also showed medical coils, tapper keys, accumulators for hand lamps, and buzzer sets with signalling lamps. Ingenious electric toys, boxes of parts for the young amateur to make up shocking coils, lighting sets, and telegraphs, &c., were shown. The firm makes a specialty of silk shades on wire frames for electric lamps, of which many artistic examples were exhibited. Various small novelties were shown at this stand. A dry battery converted into a hand lamp was noteworthy, the lamp holder being simply fixed into the sealing composition, and the switch consisting of the usual brass spring, contacting with a brass catch; nothing simpler could well be imagined.

MESSRS. CLIFFORD BROS., LTD., Birmingham, amongst a variety of non-electrical goods, showed samples of lamp-holders of various patterns, of substantial construction, and good finish; they are also makers of tumbler and turn switches, adapters, &c., a class of work which they have taken up since the war.

THE SILENT ELECTRIC CLOCK CO., LTD., London, had a stand filled with some 40 dials of various sizes, all controlled by a half-second master clock of their patent type; a special feature of the dial movement is that there is no possibility of over-shooting, the action being magnetically locked, while the absolute silence of the movement justifies the style of the firm. Other exhibits included a one-second master clock, and a master clock provided with means for synchronising by the Post Office daily time signal, or by the hourly time signal of the Standard Time Co., of which type many have been supplied to the Post Office department.

THE BRITISH EVER-READY CO., LTD., London, showed dry cells and batteries in all their well-known styles, as well as small accumulators, and a wide variety of portable lamps and torches, hand lamps, reading lamps, inspection lamps, cycle lamps, &c. Some of the hand lamps were fitted with Morse keys for signalling purposes, and others had the lens and reflector fitted on the end of the case instead of on the side, so that they would stand upright even when the battery was removed; one of these is illustrated in fig. 3. Cycle lamps in nickel-plated fittings formed an exceedingly popular line, and a hand lamp containing a battery which on emergency could be used for ignition purposes was recommended as a useful stand-by on a motor car. Ignition batteries for various voltages were shown, with the terminals covered

FIG. 3.—EVER-READY HAND LAMPS AND BELL CELL.

with insulating composition, so that if left knocking about in the tool chest they could not be short-circuited. An ordinary bell cell fitted with a simple attachment became a portable hand lamp capable of giving from 50 to 70 hours' light according to size and type. The "Flag" cell for bells, &c., is shown in fig. 3, as well as an accumulator hand lamp weighing 5¼ lb.

MESSRS. MARCONI'S WIRELESS TELEGRAPH CO., LTD., London, showed their latest ½-KW. station, in which the thermionic valve was used as the oscillation generator; the exhibit was marked by the total absence of any spark set, the valve being used up to at least 3 KW. The new direction-finder was exhibited, and the Marconi-Osram Co. showed valves up to 1 KW., while the Marconi Scientific Instrument Co. exhibited a variety of small apparatus suitable for the amateur wireless worker, but of excellent construction and finish, including the Marconi multi-valve amplifier, with six amplifying valves and a rectifier.

(To be continued.)

TRANSFORMERS AND COILS FOR X-RAY WORK.

The following are abstracts of papers read and discussed at a joint meeting of the Institution of Electrical Engineers, the Royal Society of Medicine (Section of Electro-therapeutics), and the Röntgen Society, on February 26th, at the Royal Society of Medicine.

The Efficiency of Transformers for X-ray Purposes.*

By Reginald Morton, M.D. (Trin. Tor.), F.R.C.S. Edin.

The chief object of this combined meeting is to explain our difficulty to the members of the Institution of Electrical Engineers and the Röntgen Society in the hope that they may be able to suggest a more efficient means of exciting our X-ray tubes. The essential need of the radiographer is a supply of X-rays having a high degree of actinism and with sufficient penetration to pass through the thickest parts of the body without serious loss of this actinism. A "soft" or low resistance tube gives off very actinic rays which have only a low power of penetration; we can increase this penetration by raising the voltage of the current applied to the tube, but only to a limited extent under present conditions. We can have more highly penetrating rays by using a "hard" or higher resistance tube, but this is accompanied by an equal or even more rapid, falling off in the essential property of actinism.

With the aid of an oscilloscope and a rotating mirror some very interesting phenomena are presented for our study. The coil shows us a curve having the characteristics of fig. 1, while that of the transformer is shown in fig. 2, a rectified double-sine curve. In the one we have an alternating current quite unsymmetrical in both form and duration; in the other a series of perfectly regular sine curves. The first is the more efficient for our purpose, up to the limit of its capacity. We get more penetration and more actinism for a given current, greater steadiness, less heating, and a longer useful life for the X-ray tube. A further point in favour of the coil current is that it will keep a tube working smoothly on a lower reading of the milliammeter. Every tube has a certain amount of inertia and requires a higher voltage to start it than to maintain it in action; the sudden rise at the moment of "break" readily overcomes this inertia.

It is generally agreed that penetration is dependent on electron velocity within the tube, which in turn is dependent on the impressed voltage. Thus, it would appear that the impression of a sustained high voltage on a tube in the best condition to ensure the greatest actinism should meet our every requirement. By "sustained" I do not mean "continuous." The ideal current is one consisting of extremely high-voltage impulses, of very brief duration as judged by ordinary standards, yet sufficiently sustained to have an appreciable time factor. Such current as would pass through the tube by virtue of those lower voltages represented in the lower part of the above curves should be suppressed or diverted. If the voltage of the initial impulse be sufficiently high and sustained for even a small fraction of a second, one will be enough for any ordinary purpose in radiography.

This being the case, the question naturally arises why the coil is unable to meet our requirements, considering the enormous voltage available at the moment of "break." The initial rush of current has a very high magnitude, but its duration is extremely short. This is partly due to the self-induction of the secondary, cutting off this rush of current almost simultaneously with its birth. It is also due in no small degree to something inherent in the X-ray tube itself. Notwithstanding its brief duration it is this impulse that makes the coil current so efficient up to the limit of its capacity. It is the absence of any such high-voltage impulse that keeps the efficiency of the transformer current so low. For the same current through the same tube, the top of the transformer curve extends little more than half-way to the highest point of that of the coil.

Of the total radiation from a tube energised by a coil, probably no more than 20 per cent. consists of useful rays; energised by a transformer the proportion is probably less than 10 per cent. So long as the radiologist takes milliamperes as his sole criterion, quite regardless of how they are made up, just so long will the further improvement of existing apparatus be delayed. Yet improvement in efficiency is not only possible but easy, and manufacturers will readily do this for us if only we make reasonable demands backed up by knowledge of what we really do want. As an instance of the present state of things, take the case of a certain mercury break to which is attached a mechanical rectifying device that has achieved some success. I arranged the rotating wires to pass fairly close to the collectors, giving the latter the form of a sector. Following the lesson of the spark-gap, I shortened the sector to a point, and finally altered it to a ball. Then I began to increase the clearance between the ends of the wires and the balls, and every alteration was followed by a gain in efficiency, steadier action, less heating, and longer life of the X-ray tube.

Efficiency was improved (1) by the use of a spark-gap, (2) by increasing the resistance in the secondary circuit of my mechanical rectifier, and (3) by shortening the collecting blades in the Snook machine; all three being no more than the provision of one or more air-gaps in the secondary circuit.

It being my firm opinion that the initial impulse is the only part of the cycle that matters for our purposes, this is where we should concentrate our attention with a view to increasing its height—quite feasible, as the success already attained with the "single flash" coil proves—or by prolonging its duration, which may be more difficult. So far we have only partly succeeded in giving it an appreciable time factor. If we could do this, even to the extent of a very small fraction of a second, the problem would be solved so far as the requirements of medical diagnosis are concerned. I am disposed to regard what is known as the "single flash" monster coil with at least a friendly eye. Nothing else is possible if one is to be consistent. Long before I had an opportunity of seeing one that is in regular use and the most excellent results obtained, I had committed myself to the opinion that the system was not only sound but in all probability would

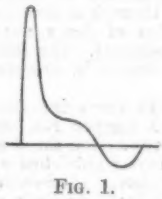

Fig. 1.

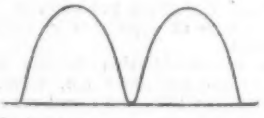

Fig. 2.

ultimately prevail. At King's College Hospital, under Dr. Robert Knox, extraordinarily fine results are regularly obtained. The apparatus is a revelation of simplicity, silence, and high efficiency. Exposures are the same for all parts, only the intensity of the discharge being altered by the primary resistance to meet the varying thickness of the different parts of the body. The best results are obtained with tubes of very low resistance, giving most beautiful contrast, a wealth of detail, and absolute sharpness of outline, even in the case of the heart. The effect of these intense discharges on the life of the X-ray tube is much less prejudicial than time exposures. It is my firm conviction that the future of radiography is bound up more or less inseparably with the "single flash" system, and manufacturers would do well to give this matter their very serious consideration.

Problems of Interrupted and Fluctuating Currents.

By Major C. E. S. Phillips, O.B.E.

The velocity and quantity of the electrons in an X-ray bulb are the principal factors controlling the design of electrical apparatus required for radiography. Since the potential difference between the electrodes of the tube determines the speed of the electron and therefore the quality of the X-radiation produced, the electrical problem resolves itself mainly into one of engineering. The potential difference necessary is, however, exceptionally high, and the machines and appliances require to be specially designed. In addition to the requirements of medical practice there are other calls for highly penetrating rays; metallurgists are asking for a machine that will give 300,000 volts. For instantaneous radiography in medical institutes large currents are also needed at these high voltages, so that the demand in this respect is, in fact, always ahead of the supply. In some cases the power put into the tube itself has exceeded 14 kw. On the other hand, there is the radiography of wood and a wide range of other uses necessitating only moderate electrical plant.

The induction coil has much to recommend it. The simplicity and absence of moving parts are great advantages. In the interrupter lies our principal limitation, and our troubles are divided between it and the condenser. The shape of the condenser is of importance; of two condensers with the same capacity the one having long narrow leaves is not so effective as one in which the leaves are nearly square.

One of the causes of coil breakdown during the war was fracture of the wax during transport. It is suggested that a fairly thin oil could be used as an insulator, thin enough to draw off before transport, and it should be possible to replace the oil without creating air cavities. The secondary could be wound with No. 36 aluminium wire and thus save one-third of the weight of copper. An improvement from an Army point of view could also be effected by using a removable core. A coil so designed would be extremely portable on account of the distribution of weight.

The weakest point of a coil outfit is undoubtedly the condenser. An alternative path should always be provided to carry off any excessive surges of current into the condenser. Recent experiments in this direction at the War Office X-ray laboratory have shown that a condenser, while in use, may be short-circuited through a water resistance (3 inches of tap water, using fine copper wires just dipped below the surface)

* Throughout the body of this paper, as distinct from the title, the word "transformer" refers to apparatus having a closed magnetic circuit as distinguished from the "coil" with its open straight core.

with a reduction of only 20 per cent. of the coil output. Three 16-C.P. 250-volt carbon-filament lamps in series joined across the condenser terminals proved quite satisfactory. The filaments glowed a dull red, and irregular surges of current were indicated by momentary brightening of the lamps, but there was no appreciable reduction of coil output, and the plan will, I hope, reduce condenser breakdown in future to a minimum.

The value of the interrupted current that may be safely used with a coil is limited owing to the flare when the primary current is broken. Interrupters are frequently imperfectly designed and constructed. Experiments with tantalum blades are required, for in tests already made there is indication that flare can by this means be reduced. Although tantalum is not "wetted" by mercury, it nevertheless gives a perfect contact. The arc at break occurs in that case between the practically non-vaporisable tantalum and the mercury, and the speed of the motor assists in giving a sharper interruption of the circuit. In other cases the high surface tension of the mercury determines the suddenness of the rupture.

The design of transformers has reached a high degree of perfection. Their electrical efficiency is remarkable, but where very high-tension work is concerned (as in X-ray technique) and a rectifying disk is spun by a synchronous motor, the weak spot of the installation practically always seems to be the insufficient guarding of the armature windings from induced surges of current. Earthing through a condenser, or other means of assisting the insulation of the armature to withstand the strain put upon it, is essential. The reliability of this type of apparatus in skilled hands is, however, remarkable.

One serious objection to the transformer arises from the form of the secondary P.D. wave. A steeper P.D. wave is required. In 1895, and about six months before the discovery of X-rays, Messrs. Barr, Beeton and Taylor published a paper in the *Electrician* dealing with the question of changing the shape of alternator wave-forms. They keyed to their experimental alternator a special commutator called by them an "injector," by means of which inductance or capacity, or both, could be introduced into the circuit at regular intervals. In this way remarkable distortion of the original wave-forms was obtained without sparking. It is suggested that the wave-form of the current for the transformer be distorted synchronously by keying an "injector" to a small synchronous motor and connecting it in series with the main supply and the transformer. In this way a wave-form could be obtained which would render the rectifying disk unnecessary. The installation would not only be less costly, but would weigh less, occupy less space, and be highly efficient for the requirements of X-ray technique.

High-tension Transformers for X-ray Work.

BY RUSSELL S. WRIGHT, M.I.E.E.

THERE are probably very few scientific instruments on which so little systematic research work has been accomplished as the subject of this paper. We have not yet even reached a satisfactory classification as regards either output or efficiency.

In the case of an induction coil, I am not convinced that we have, as yet, any means of ascertaining what the peak value of our discharge really is, as it is quite certain that the point of highest potential is only maintained for an exceedingly short interval of time, and it is doubtful whether any recording instrument at present available will really measure it. There seems every indication that the wave-form most suitable for radiography is not equally so for therapy. If this is the case, the question arises whether one instrument can be made from which outputs of sufficiently variable wave-form can be produced at will, or whether the same type of discharge is always suitable even for, say, radiography alone. Our ignorance of what is really required is at present a bigger obstacle to progress than the corresponding problem of how to obtain it. I would suggest that the time is now ripe for a definite move forward, and that radiologists, electrical engineers, and physicists should, so to speak, come into partnership in the attempt to solve a very baffling problem, and I would further suggest that the British Scientific Instrument Research Association is the proper body to co-ordinate and direct the work of the three so as to produce reliable results.

In the case of the transformer the problem is a simpler one, as we are at all events dealing with a curve of sinusoidal character.

In the original interrupterless machine as introduced by Snook, we had in fact a real sinusoidal curve with every alternate wave inverted. In the modern machine the curve has been somewhat modified and is no longer strictly sinusoidal or even symmetrical, but may be represented as in fig. 3. The direct measurement of such a current by means of an ordinary moving coil milliammeter is both more correct and more consistent than is the irregular discharge from an induction coil. The conditions of work with an interrupterless machine can be more exactly reproduced from day to day than is the case with an induction coil, and the readings of the milliammeter are more reliable.

A closed-circuit transformer also adapts itself far better to the indirect measurement of its output than does the induction coil, for the simple reason that its electrical efficiency is far higher and more easily computed. This question of efficiency is absolutely unimportant in one sense, but if it can be ascertained, it assists enormously in calculating the secondary output.

I should be inclined to suggest that an A.C. H.T. transformer be taken as the basis on which to work, and that an attempt be made to classify induction coils according to their effective outputs for the purpose of the radiologists and compared with a transformer of standard size and efficiency.

Assuming, therefore, that this suggestion is accepted, how should a transformer be rated? Before deciding this it must be borne in mind that what to an electrical engineer is a big overload is to the manufacturer of X-ray apparatus a normal condition, as in X-ray work machines are in practice only used to their full output for a fraction of a second at a time. An overhead rating is, therefore, perfectly justifiable, and our earlier machines were so rated by about 100 per cent., but when a machine was put on the market by an enterprising foreign firm rated at an overload of well over 1,000 per cent., I felt that the position was getting ridiculous, and I notice that now practically every responsible firm refrains from mentioning outputs in kilowatts at all.

The life of both transformers and coils is far less than it was ten or even five years ago, and few of the equipments being turned out to-day will permanently withstand the strain of modern conditions. The continual use of a coil for "deep therapy" is undoubtedly the most prolific cause of breakdowns at the present time.

If one considers that an output of, say, 3 milliamperes at a 12-in. spark-gap from an instrument capable of giving, say, 100 milliamperes, means that it is kept at a high potential on practically open circuit for long periods at a time, one

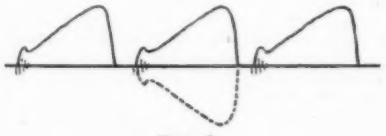

FIG. 3.

will realise at once the problem we are up against. Examining the exposed end of a secondary winding in this condition, we can see that it is in a constant state of effluve and that the discharge is literally spitting away in all directions.

It is impossible to look at this effluve without feeling that sooner or later the insulation is bound to go, and go it invariably does if the strain is continued long enough. Just now the position is made worse by faulty material, but in any case a coil or transformer, constructed to give a heavy output for radiographic work and with dry insulation, cannot be continually used for deep therapy without the risk of trouble.

Various devices can be used to safeguard more or less the end windings, but the only real remedies are two: either we must wind an instrument for deep therapy alone, or we must adopt oil insulation.

DISCUSSION.

Prof. SALOMONSON, who had come specially from Amsterdam to take part in the discussion, said that in practice he could not see any appreciable difference between the transformer and the induction coil. Quite as good a picture was obtained with the coil as with the transformer. Therefore, they should not decide as to the value of either apparatus merely from the point of view of the results obtained. Other considerations must determine the choice, according to the particular work in hand, such as whether it was special radiographic work or therapeutic work. Where extremely high pressure was required the coil was best, because it was cheaper, and if breakdowns occurred—as they inevitably did with either apparatus—the coil was more cheaply repaired than the transformer. There was very little known regarding the efficiency of the coil or the transformer. He had developed a new method in which the secondary was connected up to a tube through which a stream of water flowed, the water being heated by the secondary current. He measured the amount of water flowing per second, and the temperature of the water at the inlet and at the outlet, and from these three data he was able to deduce with considerable accuracy the quantity of energy given out by the coil. He had also developed a method for measuring the efficiency of transformers by taking two transformers and connecting them together on the high-pressure side. The energy put into the first and the energy taken out of the second were measured by ordinary wattmeters, and from the result it was possible to deduce very accurately the efficiency of each of the transformers. Experiments on a transformer of the Snook type and one made by a German firm, both rated at 4 KW., gave an efficiency of 0.9 in the case of the Snook, and 0.89 in the case of the German machine as used in ordinary practice; when they were loaded to their fullest capacity, the efficiencies were a little higher. Measurements were also made on three induction coils in the same way, the average effi-

ciency being about 0.8 in the case of certain German coils and a little lower in the case of a coil by a British firm, due to the larger quantity of insulating material used. With interrupted current the efficiency worked out to 0.68 and 0.75 in two cases. When using a rectifier the efficiency fell to 60 or 65 per cent. When measuring the efficiency with the interrupter the results were a little worse, and the figures showed that although the quantity of energy put into the coil was increased to nearly double, there was only a slight increase of the secondary output, and the efficiency fell off to quite small numbers, the greater part of the current being absorbed in the interrupter. Therefore he agreed with Major Phillips that the interrupter should be made a subject of serious research; he was convinced that with a better interrupter improved results would be obtained with the coil.

Prof. Fortescue said it had been shown that high voltage was necessary, and that it was useless to pass a large quantity of electricity through the tube at a low voltage, because this merely resulted in heating up the tube. Whether they used a coil or a transformer, some part of the current was at high voltage and some part at low voltage, but if the method was used which had been developed recently in connection with wireless telegraphy, viz., a hot-filament rectifier and a condenser, it was possible that the whole discharge through the tube—at any rate with the Coolidge tube—could be at high voltage. In wireless telegraphy this method gave an efficiency of 60 to 80 per cent. It was true that at present this method did not go beyond voltages which would be considered low for radiographic work, but the method promised a means of getting over the difficulty that had been mentioned.

Major G. W. C. Kaye thought it could almost be said that radiology was in a hopeless state with regard to units of measurement. There was no unit of radiation. At present the methods of measuring radiation were childish and ineffective; so, also, were their methods of measuring current through the X-ray tube. They did not, as a rule, know the wave-form either of voltage or current. Not one radiologist in a hundred took the trouble to measure the voltage across the tube properly. The average radiologist usually contented himself with measuring the sparks between the points, but as the American Institute had recently shown, the ordinary point gap might be 300 or 400 per cent. in error on large gaps, and the only way to measure voltage was by the use of sphere gaps, the spheres being as large as the maximum gap which was to be employed. Experiments on measuring voltages by sphere gaps had shown that the efficiencies obtained in X-ray work were such as to appal the electrical engineer. They started off by having a 90 per cent. efficiency for the transformer and 50 per cent. in the case of the X-ray tube, but the energy they put into the tube had an efficiency of the order of 20 per cent. with a coil-driven tube, whilst in the case of a transformer-driven tube an efficiency of perhaps 10 per cent. was a fair figure. In these circumstances, it did not matter much what the method of exciting the tube was. They should put their heads together to remedy that state of things.

Dr. A. E. Barclay showed a number of slides illustrating the difference between a coil and a transformer for X-ray work as regarded output. He said the milliampere was utterly useless as a unit of measurement to the radiologist; the character of the impulse counted materially in the production of X-rays, and it was the first part of the impulse which counted; what came afterwards did not matter at all.

Mr. R. C. Clinker wished to know what was really shown by the oscilloscope—the voltage or the current of the supply to the tube. It was necessary to separate the ideas of voltage and current before it would be possible to get a clear idea of what would be supplied by the tube. Dr. Morton first referred to voltage in his paper and then to current. It was clear that what was wanted was high voltage, and the suggestion of Prof. Fortescue was a good one. With regard to the work of Barr, Beeton, and Taylor, he thought a great deal could be done by working the transformer at a high magnetic density in the core and using a resistance in series. In that way it was possible to get almost any wave required, and such a transformer would supply the same maximum voltage as the coil.

Dr. Owen said a new theory with regard to the coil had been put forward by Prof. T. Jones, to which very little attention had yet been given. The concordance between the theoretical and practical results was remarkable. Coil makers ought to see what they could do to improve the induction coil on the lines of that theory before practitioners turned their backs upon the coil once for all.

Dr. Harrison Orton said the cry for more and more milliamperes was one of the chief obstacles in the path of progress, because the milliamperemeter was a misleading and unreliable instrument. Why should it be assumed that the milliamperemeter reading of a transformer current indicated the same thing as that of a coil current? From practical experience, it was evident to him that it was not so. The maximum impulse from a coil was of extremely brief duration, so brief, in fact, that the milliamperemeter, as at present constructed, was incapable of recording it, and he suggested that if the true milliamperage of a coil current could be measured it would probably be found that it was less efficient than the transformer. The superiority of the coil over the transformer did not exist. At present he did all his therapy with the coil and all his radiography with the transformer, and that gave the most satisfactory results. The difficulty with the oil transformer was that it would not stand the overloading necessary to obtain rays suitable for therapy, and it was more difficult to get replacements. For radiographic work radiologists required a machine which would give a current of high potential for a tube giving a 12- to 14-in. spark gap, and it must be able to stand such a potential for very long periods of working, and enable the full dose to be given for four or five minutes. They wanted a machine to obtain radiographs at a greater distance from the tube and in less time than at present, and without an intensifying screen, and in designing such a machine the type of tube to be adopted must be taken into consideration.

Mr. W. E. Burnand said that the difference in results obtained with a transformer and a coil was largely due to the great rise in useful rays from the tube as the input energy was increased. If it was taken that the output of useful rays varied as the cube of the applied voltage and the curves of potential were plotted out, it would be found that the upper parts of the voltage curves were the only ones that mattered. The other chiefly heated up the tube. Major Phillips had referred to a million-volt transformer. He believed that one or two of them had been made in the States and worked, but not for long. They preferred to work at 500,000 volts, but even then it should be remembered that the insulator would have to be 10 ft. long, and the apparatus would weigh 20 tons and cost £10,000. The amount of energy required in the tube was a comparatively small item. Although it was quite impossible with present-day materials to keep up the high voltage required for any length of time, it might be possible to develop an apparatus that would give it long enough to give a regular discharge from the tube, say, 1/200th of a second. The apparatus he proposed for that would be substantially a transformer with an air gap in the magnetic circuit and excited by a small direct current. By that means it would be possible to pass a direct current of 500 watts for a matter of, say, five seconds, and the energy represented by that would be stored in the air gap, not the iron, and would be discharged when the circuit of the primary was broken in 1/200th second. That would give a matter of 200 kw. for that short period of discharge. He was constructing such an apparatus. The thing would weigh about two tons, and if any enthusiast would like to bring his tubes and test them on it, when the apparatus was ready, he would risk the transformer. He had a variable air gap, so that the intensity of the discharge could be varied, as well as the quantity, and they could start up at a low value and increase it until one or the other "busts up."

Dr. F. J. Harlow said that the first thing to be taken into account in the question of the design of a generator for high-tension current was the tube. There was quite a difference in the characteristics of the gas tube and the Coolidge tube, and it was quite conceivable that the machine employed to develop the high-tension current would have to be different in both cases. He showed curves illustrating the difference in the characteristics of the tubes. He did not think the oscilloscope showed the voltage characteristics at all, but agreed with Dr. Morton that the effect of the spark gap in the secondary was to cut down the low-voltage current. He was inclined to think that the proper wave form was one in which the voltage rose immediately to the high value, remained there for the time it was required, and then went back to zero, so that there was no low-voltage current passing through at all. Experiments had been carried out in his laboratory on absorption curves obtained from different machines. It would appear that the same character of X-rays was obtained from the tube under the different conditions, whether coil or transformer was used, but the energy which was put in in the two cases appeared to be absorbed entirely in the tube. There was the same radiation sent out by the tube, but the energy which was got from the low-voltage current was simply absorbed in the tube and was not emitted.

It was decided to adjourn the meeting until a date in the autumn, to be announced later. The hope was expressed that during the interval experiments would be made in an endeavour to elucidate some of the points raised in the discussion.

Exhibition of Apparatus.

In connection with the meeting, some half-dozen firms exhibited X-ray apparatus, and we give brief particulars of the exhibits below.

Messrs. Watson & Sons, London, showed a 10-k.v.a. high-pressure transformer with a rotary high-pressure rectifier, and in this connection it is interesting to note that the first Government radiometallographic laboratory has recently been equipped by Messrs. Watson. The firm has decided upon the closed iron type of transformer, the insulation being of the "dry" type, as opposed to oil immersion, and the firm holds the view that the future will see a more general adoption of the closed iron dry insulated transformer. As will be seen from the discussion on the three papers, it is a very difficult matter to estimate accurately the output of transformers, either from an electrical or radiographic standpoint, but two types of this machine, as an approximate guide, have been designated ten and five k.v.a. respectively. The frequency-reducing device can be fitted to either machine, and is found to be of great advantage for screen work, owing

to the lessened heating effect on the tube. Its adoption is recommended in all cases where the ordinary gas tube is used. The rectification of the high-pressure current is arranged by means of a disk of special insulating material mounted directly on the shaft of the rotary converter or synchronous motor, as the case may be. The collecting segments are arranged so as to utilise only the crests of the waves, thus reducing the heating of the tube to a minimum. Auto-transformer control can be incorporated. There was also exhibited a new instrument devised by Major G. W. C. Kaye in the form of a sphere-gap voltmeter.

The Solus Electrical Co., London, exhibited a large number of apparatus. A Solus centrifugal gas mercury interrupter designed by Mr. Eric J. Ward Watkinson, proprietor and manager of the business, is the only one of its kind. It consists of a revolving ring of mercury, with an insulated fibre ring with copper segments rotating in the mercury. The gas dielectric is claimed to be much cleaner than paraffin. A "Solus" Patterson fluoroscopic screen is a new screen from America, giving much greater brilliancy and fluorescing a mild blue. It is claimed for these screens that they are absolutely stable, the chemical coating not being affected by heat or damp, nor by the continuous bombardment of the X-rays. These Patterson screens are intended for 24-hour service every day, and they are used almost universally throughout the United States. The "Solus" tube stand has a patent double ball and socket joint, and any movement of the X-ray tube may be made without undoing any clamping device.

Messrs. Kodak, Ltd., London, showed their Wratten X-ray plates.

Messrs. Newton & Wright, Ltd., London, showed "Simplex" X-ray apparatus, the feature of which is that all moving parts can be eliminated if an A.C. supply is available. This feature is made possible by the radiator type of Coolidge tube, which has the property, within limits, of completely rectifying an alternating current, so that the apparatus can be energised by a high pressure transformer without the aid of any mechanical or other form of rectifier. When a direct-current supply only is available, a rotary converter can be included to produce the necessary A.C., but this machine need not necessarily be contained in the apparatus itself, but can be fitted in another room. In the Simplex No. 1 apparatus, the output obtainable has been limited and fixed in quantity, as by so doing it is possible to make the efficiency of the transformer so high that, while keeping the power employed within the limitations of ordinary electric light wiring, X-rays of very reasonable volume can be produced. The apparatus can therefore be worked from an ordinary electric lighting socket, without any special wiring being required, and under these conditions an output of up to 5 milliamperes at a 5-in. equivalent spark gap can be obtained, according to the voltage of the supply mains available. Owing to the output being a fixed factor it is only necessary to vary the time of exposure according to the part of the body which it is required to radiograph, and a simple chart is being prepared, showing at a glance the exposure required. An interesting dental unit was also shown.

Mr. Cuthbert Andrews, London, exhibited modern gas-filled X-ray tubes with tungsten or platinum targets, and cooled by various means. Mr. Andrews claims to be the largest producer of X-ray tubes in the British Empire. He also showed protective appliances, including gloves, masks, aprons, &c., and glass, high-frequency electrodes, microscopes, and microscope accessories. All the apparatus on view had been manufactured throughout in his own workshops.

NEW PATENTS APPLIED FOR, 1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens (successors to W. P. Thompson & Co., of London), Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

4,640. "Electric switches." Midland Electric Manufacturing Co. and H. E. Sutherland. February 16th.
4,641. "Fastenings for hinged covers of boxes or cases." Midland Electric Manufacturing Co. February 16th.
4,661. "Attachment of dynamo for lighting side-car combination." S. G. Muir. February 16th.
4,662. "Electrically-driven mechanism." J. H. Hansen. February 16th.
4,667. "Storage batteries." G. J. van Swaay. February 16th. (Holland, February 15th, 1919.)
4,676. "Electric-lamp mountings." L. T. Dixon. February 16th.
4,679. "Electric hand lamps." E. V. Hayes-Gratze. February 16th.
4,681. "Control of excitation of dynamo-electric machines." British Thomson-Houston Co. and F. H. Clough. February 16th.
4,696. "Selenium cells or bridges." H. F. Knight. February 16th.
4,713/4/5. "Electric transformers." Hackbridge Cable Co. and W. C. Kennett. February 16th.
4,728. "Electric irons." R. Cox. February 16th.
4,737. "Line selector switches for intercommunication telephone systems, &c." E. W. Holland, G. S. Holland and H. E. Holland. February 16th.
4,739. "Valve transmitters for wireless telegraphy and telephony." A. K. Macrorie and G. Shearing. February 16th.
4,764. "Protecting electric cables and wires from being accidentally pierced." J. H. C. Brooking and St. Helens Cable & Rubber Co. February 17th.
4,766. "Sensitive-pressure relays for amplification of sound waves, &c." F. W. Baynes. February 17th.
4,780. "Adjustable carrier for electric lamps." H. R. Henderson and D. B. McIntosh. February 17th.
4,786. "Magnet for device for indicating during heating if a body has reached the critical point." G. S. Crawford. February 17th.
4,790. "Electric fires." C. B. Kersting and L. L. Lane. February 17th.
4,792. "Electric incandescent lamps." J. F. Poynter. February 17th.
4,795. "Electric induction-gas radiator." W. Boller. February 17th.
4,799. "Wireless communication." W. H. Eccles and J. H. Vincent. February 17th.
4,809. "Power-transmission systems." British Thomson-Houston Co. and F. H. Clough. February 17th.
4,810. "Electric power-transmission devices." British Thomson-Houston Co. (General Electric Co., U.S.A.) February 17th.
4,812. "Sparking plugs." G. E. T. Archer, F. O. Ellis and S. E. Taylor. February 17th.
4,829. "Automatic telephone systems." Automatic Telephone Manufacturing Co. February 17th. (United States, April 11th, 1919.)
4,832. "Sparking plugs." G. E. Lemoine. February 17th. (France, March 19th, 1919.)
4,863. "Insulating splice covers." J. B. Hamilton. February 17th.
4,887. "Connectors for cable suspension or straining means." G. V. Twiss. February 17th.
4,915. "Bonding-clips for electric wiring systems." J. C. White. February 18th.
4,916. "Junction box for electric wiring systems." J. C. White. February 18th.
4,919. "Inspection lamp for viewing interiors of casks, cylinders, &c." R. J. Lowthian. February 18th.
4,934. "Locomotive or electric engine stop signal." G. Taylor. February 18th.
4,947. "Governing mechanism for prime movers." British Thomson-Houston Co. February 18th.
4,950. "Control mechanism for electric cars with pneumatic brakes." Westinghouse Electric and Manufacturing Co. February 18th. (U.S.A., February 18th, 1919.)
4,958. "Primary cells and batteries." R. W. Clark. February 18th.
4,959. "Electric heating apparatus." E. J. Harman and E. Le Bas. February 18th.
4,965. "Apparatus for holding X-ray tubes." Siemens & Halske Akt. Ges. February 18th. (Germany, December 28th, 1917.)
4,970. "Means for indicating at a distance movements of a shaft, &c." Igranic Electric Co. (Cutler-Hammer Manufacturing Co.) February 18th.
4,979. "Distributing terminals for ignition magnetos." Fabriques des Montres Zenith, Successeur de Fabriques des Montres Zenith G. Favres-Jacot et Cie. February 18th. (Switzerland, February 11th, 1919.)
4,986. "Bayonet sockets for electric lamps." J. Wegmann. February 18th. (Switzerland, February 22nd, 1919.)
4,991. "Magneto-electric machines." G. M. Turner. February 19th.
5,000. "Process for production of flexible zinc." S. O. Cowper-Coles. February 19th.
5,007. "Electric incandescent lamps." F. Brighouse. February 19th.
5,008. "Sparking plug." W. Duerden and F. Rigby. February 19th.
5,024. "Electric fuses, switches, &c." Midland Electric Manufacturing Co. and H. E. Sutherland. February 19th.
5,025. "Electric distribution fuse-boards, fuse-boxes, &c." Midland Electric Manufacturing Co. and H. E. Sutherland. February 19th.
5,039. "Arrangement for protecting telephone installations from currents of dangerously high tension." A. Perego. February 19th. (Italy, November 23rd, 1918.)
5,040. "Removal of iron from solutions containing aluminium." Norske Aktieselskab for Elektrokemisk Industri Norsk Industri Hypotekbank. February 19th. (Norway, February 22nd, 1919.)
5,051. "Intercommunication telephone systems." L. C. Bygrave. February 19th.
5,066. "Electrode-holders for welding, soldering, or brazing metals." W. Blair and Sunderland Forge & Engineering Co. February 19th.
5,072. "Electrical apparatus for transmitting indications to a distance." M. P. Favre-Bulle and M. J. Lavet. February 19th.
5,097. "Dynamos for lighting and starting devices upon motor vehicles." J. R. P. E. F. M. Grimaud. February 19th. (France, June 13th, 1919.)
5,125. "Incandescent electric lamp projectors." E. Booth and N. R. Booth. February 20th.
5,127. "Plugs for motors, &c." M. MacGregor. February 20th.
5,136. "Electric switches." J. A. Crabtree. February 20th.
5,144. "Dynamo-electric generators and motors." S. Macdonald. February 20th.
5,152. "Galvano-therapeutic appliances." E. Brem. February 20th.
5,161. "Electric switches." H. D. Pyne. February 20th.
5,164. "Electric ignition, &c., systems for internal-combustion motors." H. A. Smith. February 20th.
5,165. "Sparking plugs." A. W. Armstrong. February 20th.
5,172. "Signalling systems." British Thomson-Houston Co. (General Electric Co., U.S.A.) February 20th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1918.

18,895. Direct-driven electric lighting apparatus for cycles and other road vehicles. C. F. Dufaux. November 16th, 1917. (120,917.)

1919.

512. Electric lamps for motor vehicles and for other uses. G. A. Edman. January 8th, 1919. (138,147.)
1,416. Supporting insulators for electric high-tension conductors. E. Schwank. January 21st, 1918. (122,642.)
2,212. Trolley heads for electric trams and other purposes. A. Bannister and T. W. Tucker. January 29th, 1919. (138,160.)
2,486. Method of and apparatus for generating ignition current. Splitdorf Electrical Co. November 9th, 1917. (123,078.)
4,817. Means for securing electric lamps or lamp holders to hand lamps and other electric light fittings. February 26th, 1919. W. Harrison and E. H. R. W. Eyre. (138,186.)
4,983. Self-contained electric battery lamps. British Every Ready Co. and M. Goodfellow. February 27th, 1919. (138,188.)
5,925. Phonographs for recording telephone conversations. H. Ullmann. March 10th, 1919. (138,196.)
6,511. Controllers for use with electric motors and so forth. R. Amberton. March 15th, 1919. (138,204.)
6,655. Protective devices for electric circuits. British Thomson-Houston Co. (General Electric Co., U.S.A.) March 17th, 1919. (138,205.)
7,316. Swivelling brackets for mounting electric generators on aircraft. F. J. Hooper. March 24th, 1919. (138,212.)
8,969. Papers for use as a dielectric for electrical condensers and other similar purposes. F. Haigh. April 9th, 1919. (138,226.)
9,206. Brush holders for use with dynamo-electric machines and for like purposes. Electric Construction Co. and P. J. Stirrup. April 11th, 1919. (138,227.)
10,483. Distributor or commutator for Ford internal-combustion engines. P. W. Coriess. April 28th, 1919. (138,234.)
12,447. Electrical switches. A. P. Lundberg, G. C. Lundberg, P. A. Lundberg, and G. Pegg. May 17th, 1919. (138,240.)
14,760. Electric insulators. H. Lutz. June 11th, 1919. (138,257.)
17,491. Electric weft feeler arrangement for weaving looms. H. Ter Kulle. August 23rd, 1918. (131,582.)
19,383. Material for the manufacture of electrodes of electric furnaces. O. R. Olsen. August 6th, 1919. (139,275.)